VOL. XVI.
No. CCCLXXXVI.]

APRIL 18, 1885.

[PRICE,
FOURPENCE.

APR 28 1885
COLLEGE LIBRARY

THE
TELEGRAPHIC [illegible] AND
ELECTRICAL REVIEW

LONDON: PUBLISHING OFFICE, 22, PATERNOSTER ROW, E.C.—SUBSCRIPTION per annum, Postage inclusive, in Great Britain, 19s. 6d.; to Countries in Postal Union, of the first class, 21s. 8d.; of the second class (Aden, India, Persia, &c.), 23s. 10d.—NEW YORK: D. VAN NOSTRAND, 23, Murray Street, and 27, Warren Street. Paris: Madame VEUVE J. BOYVEAU, Librairie Etrangère, 22, Rue de la Banque. BERLIN: A. ASHER & Co., 5, Unter den Linden.

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THE TELEGRAPHIC JOURNAL AND

Electrical Review.

VOL. XVI.—NO. 386.

THE ELECTRIC LIGHTING ACT.

A CURT reply that may not seem very full of promise to electric lighting interests was given by Mr. Chamberlain on Monday to the question put to him by Mr. Stanhope as to whether it was his intention to introduce a Bill this year in amendment of the Electric Lighting Act. Indeed, at first sight it would almost seem as if the hopes and aspirations of the committees which have been agitating in the matter had received a fatal blow by means of the simple negative utterance of the President of the Board of Trade. But before arriving too hastily at the conclusion that Mr. Chamberlain maintains an antagonistic attitude towards those who desire a change in the legislation relating to electric lighting, it may be as well to glance beyond the immediate question and survey the circumstances, extraneous so far as directly affecting that question, but which might still influence a Minister in returning such an answer. In the first place it is quite within the range of possibility that ere the termination of the present year a General Election may take place, and it is impossible to anticipate what changes such an occurrence would involve. The course of the present Government is, we may safely assert, nearly run: in the natural order of things it cannot last much longer, and Mr. Chamberlain is not likely to introduce any important measure at a period when dissolution cannot long be delayed. If an amendment of the Electric Lighting Act is to be made, it is important that it shall be thorough and complete, and in order that this may be, time must elapse during which due inquiry may be made and mature consideration given to the results of such inquiry by those responsible for the change. It would be but a perpetuation of previous mistakes to hurriedly push through Parliament a hastily prepared and incomplete measure; and looking to the present aspect of public affairs, and the little time which it will be possible to devote to domestic matters of this description, it would perhaps be inadvisable to bring forward the matter just now. Therefore Mr. Chamberlain's reply may be taken as not necessarily unfavourable. Reasons are obvious why a more detailed reply would be out of place. Before that amount of attention which the matter undoubtedly deserves can possibly be given to it a change of Government may take place: the Conservatives may be in power, or, if the Liberals still have the preponderance, a reconstitution of the Ministry would not necessarily include Mr. Chamberlain, while if it did include him he would possibly fill some other office than that of the President of the Board of Trade.

Delay is inevitable, therefore, and perhaps it is better that it should be so. The representatives of the electric lighting interests, however, have no need to lose heart or to be disappointed. It is now pretty well known that Mr. Chamberlain is really anxious to place the new industry upon a more satisfactory footing as far as legislation is concerned, and it is imagined that, should he see his way clear at the commencement of next Session, or, in the event of his return to office after a dissolution, some proposal for the extension of the period ere the compulsory purchase option would arise will emanate from him. The Committee which has Lord Thurlow at its head, and which is doing its best to keep the matter prominently forward, is hopeful of success eventually, whatever Ministerial changes may take place. It is being generally recognised that the most obnoxious clause of the existing Act is really faulty, public opinion is in favour of less restriction upon the new illuminating agency, and there is a disposition, evident to those most closely concerned, to make valuable concessions. The only course, therefore, open to the electric lighting community is to wait in patience for the progress of events. A further interview, it is anticipated, will shortly take place between Lord Thurlow's committee and the President of the Board of Trade, who may then give some further indication of his views.

THEORETICAL AND EXPERIMENTAL RESEARCHES ON THE SECONDARY GENERATORS OF GAULARD AND GIBBS.

By PROFESSOR GALILEO FERRARIS.

IN the International Section of Electricity of the General Italian Exhibition recently closed at Turin, the secondary generators of Gaulard and Gibbs were exhibited by the National Society for the Distribution of Electricity by Secondary Generators, of London, with a great wealth of apparatus, and in their newest form.

These were induction apparatus which the inventors presented as a fit means for distributing at great distances and over extended surfaces electric currents for illumination or for other industrial purposes.

As I had at my disposal in the Exhibition an installation of secondary generators constructed under the conditions of a true industrial arrangement, and which could with difficulty be reproduced in a scientific laboratory, I made use of them for experiments which may contribute to the solution of the question at issue. The main controversy refers to the determination of the coefficient of yield. It is principally due to the errors springing from the use made by Hopkinson and others of the quadrant electrometer and the electrodynamometer as instruments for the measurement of alternate currents. As it is not possible to reply to these objections in a decided manner without demonstrating the agreement of the results of the experiments made with the two above-named instruments with other experiments in which they have not been employed as instruments of measurement, I, in accordance with the opinion and the wish of the International Jury of the Exhibition, made some determinations in which all the measurements were executed by means of the only instrument against the use of which no objections can be raised—the calorimeter.

The comparison between my measurements and others executed with the electrometer and the electrodynamometer will be found, I hope, instructive. The discussion of the results has led me to a theoretic study of the phenomena met with in the secondary generator—a thereotical study which, controlled by experiment, solves the question in a manner surpassing my expectations. From such a study it results:

1. That all the experiments which have been performed for the determination of the coefficient of yield, even when they have been fit to serve for such a determination have always been badly interpreted and erroneously calculated.

2. That not only from my calorimetric experiments, but from those already made by others with the electrometer and the electro-dynamometer, if rightly interpreted, the coefficient of yield may be effectively deduced; but that such coefficient has a different value from that which was believed until now, and follows a law different from that to which the erroneous interpretation of the experiments had led.

3. Lastly, that from such experiments it is possible to deduce, besides the coefficient of yield, other elements useful to be known for a complete numerical study of the phenomena of the secondary generator.

In the memoir which I now present I have sought to sum up the principal results of my researches.

The memoir is naturally composed of two parts: the first part sums up the theoretical researches necessary for the interpretation of the experiments; the second comprises the experimental researches.

PART FIRST.—THEORETICAL RESEARCHES.

SEC. 1.—*Description of the Secondary Generator.*

The secondary generators of Gaulard and Gibbs are induction apparatus, having for their object to produce by means of an alternating current of given intensity other alternating currents, representing, with a slight loss, the same energy but having a different intensity, the value of which may be made to vary as required. They consist essentially of two spirals coiled on one and the same iron core, into the first of which, the *primary*, is passed the current given by a dynamo-electric machine with alternating currents, and in the second, the *secondary*, are produced by induction other alternating currents. If, as it happens in the applications for which the secondary generators are principally intended, it is required to obtain induced currents of a greater intensity than that of the inducing current the primary spiral is made of a single piece, whilst, on the other hand, the secondary spiral is divided into several equal parts, which may, by means of a commutator, be united at pleasure into a single circuit or a multiple circuit. The opposite must be done if a case occurs when it is required to obtain at the extremity of the secondary spiral a difference of potential greater than that at the extremity of the primary.

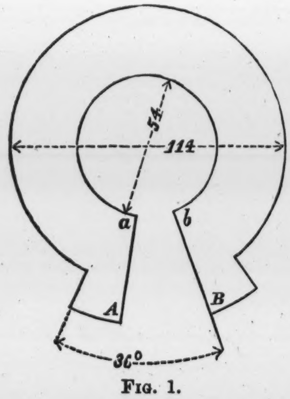

FIG. 1.

In the secondary generators of the most recent type,* such as appeared for the first time at the Electric Exhibition of Turin, the spirals are made of discs of thin sheet copper. The discs have the form of a circular crown (fig. 1) cut in A *a*, B *b*, and fitted on the two edges of the cutting with two rectangular tongues, A, B, which serve for soldering. The tongue, B, of one disc is soldered to the tongue, A, of a second disc, the tongue, B, of which is likewise soldered to the A of a third disc, and so on. By this method a ribbon spiral is formed, each disc representing one spiral. The two spirals, primary and secondary, are identical, and the spires of the one alternate with those of the other.

Insulation is obtained by means of discs with a circular crown made of pasteboard coated with shellac. The discs of the two spirals, and those of pasteboard intended for insulation are arranged in a vertical tube of vulcanite or other insulating matter, within which is introduced a cylindrical core of iron wires. Four small metal columns and two square tablets of wood, forming the pedestal and the capital, form the interconnection of the apparatus. On the capital are the ends of the two spirals and a commutator, by means of which the apparatus can be introduced at pleasure into the circuit of the primary current or withdrawn, substituting a short wire. The commutator for combining the parts into which the secondary spiral is divided into a simple or a multiple circuit is placed on an ebonite table which stands at the side of the apparatus. In order to regulate the power of the secondary generator the iron core may be withdrawn more or less from its interior. For this purpose the capital carries a screw, by which the core may be fixed at any height.

The secondary generators exhibited at Turin were of two models: a large model, calculated to absorb and transform an energy equivalent to 1·86 horse-power, and a small model arranged to absorb and transform energy about equal to 1 horse-power. The two models differ from each other merely in the number of the discs, and the number of the parts into which the secondary spiral may be divided. In the large model the secondary spiral was made of four equal parts capable of being connected either in series or quantity; in the small model the spiral was formed of two sections only.

In successive paragraphs the author undertakes an elaborate mathematical discussion of the intensity of the currents and the magnetisation of the core, coming to the conclusions that the intensity and the phase of the primary current are what they would be if the secondary generator had no existence; that the secondary current is at each moment equal and opposite to the primary current, and that the magnetisation of the iron core is null—the difference of potential at the extremities of the spirals—concluding that the difference of phase between the primary current, and the difference of potential at the two ends of the primary spiral, is equal to a fourth of the duration of the period—the energy absorbed by and recovered from the secondary generator, and the case of the secondary generator.

SECOND PART.—EXPERIMENTAL RESEARCHES.

SEC. 6.—*Notice of Preliminary Tentative Procedures for the Determination of the Coefficient of Yield.*

To determine the coefficient of the yield of the secondary generators, various methods were first tried.

In some of these investigations, having in view not so much a strict measure of the coefficient of yield as a determination of its magnitude, sufficient from an industrial point of view, the quantity of energy obtained as a useful effect of the circuit was estimated by means of electric lamps placed in the circuit. In order to judge how far the value of the energy expended in the primary circuit set the transformer in action, one of the two following methods was adopted:—

1. There was read off an electro-dynamometer, introduced into the primary circuit, the deflection produced by the current when the secondary generator was in action. It was then excluded from the circuit, and there was substituted a simple varying resistance, deprived of self-induction, reducing the deviation of the

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* A good illustration of these can be found in the ELECTRICAL REVIEW for January 10th of the present year.

electro-dynamometer to its original value. The heat evolved by the added resistance was then equal to the energy consumed in the secondary generator. An experiment of this nature was cited by Gaulard in the Session of the International Society of Electricians at Paris, February 6th, 1884. In this experiment there were in the secondary circuit lamps consuming approximately 2,710 watts per minute, with a primary current of 11 ampères. According to the assertion of Gaulard, it was found that the secondary generator, being removed from the circuit, it would be necessary, in order to restore the original intensity of the current, to introduce into the circuit a resistance of 25 ohms. It was thence deduced that the energy consumed by the secondary generator was $11^2 \times 25$, that is, 3025 watts per minute. Whence resulted, according to the described method of interpreting the experiment, a coefficient of yield equal to $\frac{2710}{3025}$, amounting to 89 per cent.

2. The secondary generator being set in action, the intensity of the principal current was measured with an electro-dynamometer. The difference of potential was then approximately determined at the two terminal ends of the primary spiral, ascertaining how many glow lamps placed in series in a circuit derived from the said ends could be brought to their normal luminous intensity. The difference of potential thus valued was finally multiplied by the current, and there was obtained a product representing the energy expended. For example, operating with the secondary generator of the experiment already cited, it was found that three Swan lamps could be actuated, placed in a single circuit derived from the ends of the primary spiral. Each lamp required a difference of potential equal to 98 volts; hence it appeared that the mean difference of potential at the two ends was 3 × 98, amounting to 294 volts, whence the energy expended was 11 × 294, amounting to about 3,230 volt-ampère per minute. It was therefore believed that the coefficient of yield was $\frac{2710}{3230}$, amounting to 84 per cent.

In order to give to the measurements a character more scientific and of greater precision, others had recourse to the use of the electrometer, excluding completely the employment of lamps, and making all the determinations, both of the primary and secondary circuit, by means of this instrument, or at least of the electro-dynamometer. The procedure adopted by such experimentalists is very simple; it is, in substance, as follows:—

By means of Mascart's quadrant electrometer, used in Joubert's manner, there was determined the mean difference of the potentials at the two terminal ends of the primary spiral, and at those of the secondary spiral. By means of the same instrument connected to the extremity of a known resistance, the intensity of the primary and of the secondary current were measured less exactly by means of an electro-dynamometer. In each circuit the product of the current appeared from the difference of the potentials measured, and there were obtained two products representing the energy employed, and that recovered in the apparatus. The quotient of the product for the secondary circuit by that for the primary circuit was assumed then as equal to the coefficient of yield.

We must note the results obtained by Dr. Hopkinson with this method of measurement, which if interpreted in the manner above given, would make us believe that the yield was = 0·96.

A more complete series of measurements has been just made at the Turin Exhibition by M. Uzel, electrician to the firm of Sautter, Lemonnier & Co., of Paris, an intelligent and able experimentalist.

I do not think it useless to state that at least one portion of his results are the most complete I have met with at present; and as a part of them were obtained with a secondary generator differing little from that upon which I afterwards experimented, they may give scope to useful comparisons.

EXPERIMENTS MADE BY M. UZEL.

PRIMARY.			SECONDARY.			$r' - \rho'$	$100 \frac{i' v'}{i v}$
i	v	$i v$	i'	v'	$i' v'$		
SMALL COLUMN CONNECTED IN SERIES.							
12·13	18·	218·34	11·58	14·30	165·69	1·20	75·84
,,	25.6	310·53	11·33	22·	248·86	1·90	80·12
,,	33·5	406·36	11·13	29·40	327·22	2·64	80·52
,,	43·	521·59	10·57	39·40	416·46	3·70	79·84
,,	56·7	687·77	9·58	53·16	509·27	5·50	74·05
,,	66·4	805·43	8·48	63·70	540·18	7·50	67·07
,,	74·	897·62	7·58	71·	538·18	9·40	59·95
SMALL COLUMN CONNECTED IN QUANTITY BY TWOS.							
12·13	23·4	283·84	24·05	9·70	233·28	0·40	82·18
,,	48·	582·24	19·68	22·15	435·91	1·12	74·87
,,	63·	764·19	15·46	29·60	467·62	1·90	59·88
,,	72·6	880·64	13·11	35·	458·85	2·60	52·10
,,	80·	970·40	10·19	39·40	401·49	3·80	41·37
LARGE COLUMN CONNECTED IN SERIES.							
12·13	23·4	283·84	12·02	15·	180·30	1·24	63·52
,,	31·4	380·88	12·	24·	288·	2·	75·62
,,	53·	642·89	11·83	45·	532·35	3·80	82·81
,,	70·	849·10	11·73	65·	762·45	5·50	89·80
,,	93·	1128·09	11·58	87·	1007·46	7·53	89·31
,,	107·	1297·91	11·30	102·	1153·62	9·	88·88
,,	126·	1528·28	11·13	119·	1324·47	10·60	86·66
,,	145·	1758·85	10·95	138·	1511·10	12·60	85·35
LARGE COLUMN CONNECTED IN QUANTITY BY TWOS.							
12·13	43·	52·16	23·50	17·	399·5	0·72	76·59
,,	88·	106·74	22·47	40·	898·8	1·80	84:21
,,	114·	138·28	21·97	54·	1186·4	2·40	85·79
,,	149·	180·74	19·65	70·40	1383·4	3·50	76·54
,,	168·	203·78	17·	80·50	1368·5	4·70	67·16

In this table i, v represent the mean values in ampères and volts of the intensity of the primary current and of the difference of the potentials of the two ends of the primary spiral measured with Mascart's electrometer and with the electro-dynamometer of Siemens and Halske; i', v' represent the same magnitudes measured in the same manner in the secondary circuit; $r' - \rho'$ the resistance in ohms of the outer part of the secondary circuit.

The theoretical considerations developed in the first portion of the present investigation make it evident that all the processes described, founded on the use of the electrometer and of the electro-dynamometer are somewhat rough and approximate, or, as I have called them, industrial proceedings. But they have been studied setting out from a preconceived idea and have therefore been badly interpreted.

It results from theory that the product of the mean intensity of the currents (measured with the electro-dynamometer and with other instruments) by the mean difference of potentials measured with the quadrant electrometer or otherwise, do not represent the energy employed by means of the primary current to set the secondary generator in action. Such product will be equal to the energy employed only when the resistance r' of the secondary circuit = 0. In all other cases, in real, practical cases, this product has a greater value than that of the energy which is to be measured. If we reflect that the instruments of measurement used for alternating currents give indications proportional to the mean of the squares of those variable magnitudes which it is proposed to measure, it will be seen that both the product $i v$ obtained from the experiments of M. Uzel or from those of Dr. Hopkinson and the energy calculated by means of the resistance experienced at the secondary generator or of the lamps arranged in series at the ends of the primary in industrial experiments, are in turn energy really absorbed in the secondary generator.

The error depends on not having reflected on the difference of phase between the primary current and the potentials of the ends of the primary spiral, a difference which always exists when the resistance of the secondary current is not = 0. But from the given mean values of the intensity of the current and of the difference of the potentials the energy absorbed effectively in the apparatus depends on the difference of phase. It diminishes with the increase of the latter and becomes annulled when it regains a value equal to a fourth of the period, whilst, on the other hand, the product which these experimentalists confound with the energy absorbed, is the energy obtained when the difference of phase is made null and increases thence to a maximum when the resistance, r', reaches infinity. The error occasioned by such inadvertence increases with the increase of r'.

Confounding in this manner the quantity, Q, with the quantity of energy really absorbed, these experimentalists have mixed with the coefficient of total yield the ratio which we have represented by m and which is not equal to the total coefficient of yield, μ, save in the limited case of $r' = 0$.

And confounding with the coefficient of total yield, μ, the ratio, m, the value of which is

$$\frac{\mu}{\sqrt{1 + \left(\frac{r' \mu}{\mathrm{C}}\right)^1}}$$

they have calculated as the coefficient of external or useful yield not the true coefficient of yield, v, but the ratio

$$\frac{v}{\sqrt{1 + \left(\frac{r' \mu}{\mathrm{C}}\right)^2}}$$

which is not only always too little, but varies with the variation of r', following a completely different law.

These considerations suffice to show that the experiments which we have classified under the name of "industrial experiments," in which it is sought to calculate the coefficient of yield by means of one or a few determinations made with electrical lamps are not only rude but absolutely void of value and meaning. They can furnish an approximate value for the ratio, m, but they cannot serve to determine with sufficient accuracy any of the other magnitudes which it is needful to know besides m to pass from it to the true value of what is sought.

The other experiments which, based upon the use of instruments of measurement like the electrometer and the electro-dynamometer, although when wrongly interpreted they led their authors and the inventor of the secondary generator to an erroneous idea on the value of the coefficient of yield and on the law of its variations, may yet serve to solve completely the problem when they form a series sufficiently extensive to give with some certainty besides the value of m that of the other magnitudes which figure in the theoretical formulæ which serve along with m for the calculation of μ. The experiments of M. Uzel, the results of which have been given above, satisfy the conditions and would be truly important if all the resistances, r', were measured instead of being calculated by means of v' and of i' directly and accurately measured.

I have been able to make use of the numbers found by M. Uzel to verify the conclusions of our theory and to determine the effective efficacy of the secondary generator. But, as independently of the theoretical considerations of which we have spoken there exist serious objections against the use of the electrodynamometer for the measurement of alternating currents, and as objections exist also against the use of the quadrant electrometer for the measurement of the differences of alternate potentials, I have made use of them to compare the theory with experiments.

On this account I shall describe some of my calorimetrical experiments, making use of the results :—

1. To verify the correctness of the measurements made with the electrometer.
2. To control the exactness of the conclusions of the theory as given in the first part of this memoir.
3. To determine the effective coefficient of yield of the secondary generator.

(*To be continued.*)

A MODEL TELEPHONE EXCHANGE SYSTEM.

WE think that it may be safely asserted that the history of invention can show no parallel to the rapidity with which the telephone has spread and become a necessary adjunct to the convenience, happiness and welfare of every civilised nation on the face of the earth.

In the great rush to adopt the telephone and to erect exchanges, however, it cannot be wondered at that in many instances *system* had to make way for *expedience*, with the result that the exchange, although in working order, failed from the lack of system to give satisfactory results, either to the subscribers or to telephone exchange managers.

We (New York *Electrical World*) propose to give our readers the details of a telephone exchange system which has had a great deal of care bestowed upon it, and which may fairly be claimed to be one of the most thoroughly organised and well arranged exchange systems in the country. The one we refer to is that of the New York and New Jersey Telephone Company, of which Mr. Wm. D. Sargent is general manager, and Mr. J. C. Rielly is superintendent, through whose personal efforts the extensive system has been brought to its present state of efficiency.

This company controls all the principal towns in Long Island and New Jersey, which include 75 cities and towns within a radius of 50 miles, extending west as far as Trenton, N.J., and east as far as Babylon, L.I. The headquarters of the system are located in Brooklyn, at No. 397 Fulton Street, where, also, is situated the Brooklyn Central Exchange office. The latter may be taken as representing a good example of the manner in which the business of an exchange ought to be conducted, and it is for this reason that we describe it. No doubt a part of the description will fit other exchanges as well, but we believe Mr. Sargent has introduced some methods which may be new to some of our readers, and may help other exchange managers to obtain information which will be of use to them in directing, enlarging or lessening the cost of their business.

The second floor of the building in which the exchange is situated is occupied by the executive offices of the company; the third floor contains the operating room, the repair shop, and the superintendent's office, in which latter the "trouble desk" is situated.

The first thing that attracts one's attention on entering the operating room is the almost complete silence that reigns even during the busiest time of day, notwithstanding the fact that 17 operators are constantly communicating with subscribers. The girls sit upon high-backed revolving chairs and a rail below supports the feet; some of them use the telephone head-gear, while others prefer the shoulder-brace. The transmitters, however, are all suspended upon rods from above, so that the hands have free play below in order to make the necessary connections with facility. They are also provided with funnel-shaped mouthpieces, so that the operator, by applying her mouth closely to the funnel, can communicate with a subscriber without raising her voice above a whisper. Indeed, so low is the whisper, and so confined by the mouthpiece, that the writer, standing within a distance of 2 feet from an operator, was unable to distinguish the nature of the communication she carried on with the subscriber.

The room contains 10 direct switch-boards, of 100 drops each. Besides this there are two circuit switch-boards of 40 wires each, and finally, four trunk wire switch-boards of 10 wires each. The direct boards carry wires each of which goes to only one subscriber. The circuit boards, however, carry the connections for lines upon which two or more subscribers are situated, and who are called up by an individual call. These boards are situated side by side along one end of the room, while the trunk line switch-boards are placed on the other side. When an operator desires to get a connection on any other switch-board in the room, no direct verbal communication is resorted to. This is avoided by the use of a dial switch, from which wires lead to every other operator in the room. By merely turning an index to a lettered stop, an operator can put herself in telephonic communication with any other in the room. Each operator has such a dial before her, situated a little to the right side, which permits of easy and noiseless communication. The switch-boards used are of the regular Western electric pattern, which are too well known to require any special description.

The manner in which the wires are led into the building is quite simple. The cables, of which there are a number, are run from the poles directly to the top of the window and into the room. The single wires end at the poles in front of the exchange, where they are joined to the wires in one or more cables (according to the number of wires on the pole), and led into the building in the same way as the other cables. Once inside the building, the wires are separated and arranged systematically on a board, but not numbered as yet. A second similar board carries all the terminals from the drops in regular consecutive order, each bearing the number corresponding to its drop. From this board connection is then made with the first board to the appropriate line wire, which is then numbered to correspond with the drop.

At this exchange no lightning arrester of any kind on the single lines is used, nor is the subscriber's instrument protected. Mr. Sargent, general manager, asserts that his experience proves them to be unnecessary, at least in large districts, and as thus far no accident has occurred on account of their absence, it is fair to assume that the position he takes in this matter is justified.

The underground telephone system of Brooklyn centreing at this station also presents some interesting facts of which a full account was given in our issue of December 27th, 1884. We will repeat here that there are in all 225 miles of conductors underground, which will allow the company to put more than three-fourths of their wires out of sight in the vicinity of the central office.

With this short sketch of the mechanical part of the system, as it may be called, we come to the clerical, and to the system of book-keeping which has been established with such good results.

As in the majority of exchanges, the hours between eight and nine in the morning are used for calling up subscribers and ascertaining the working condition of the apparatus. When any trouble is noted by the operator, such as a weak transmitter, or if the subscriber reports his receiver weak, or should a ground or cross or any other trouble be detected, the operator simply makes a note of it and communicates with the official in charge of the "trouble desk" above mentioned. The person in charge of this desk is employed solely in keeping the working of the system up to the proper pitch of efficiency. The moment any trouble is reported, the line on which it occurs is switched into communication with the desk by the operator at the switch-board, and the "trouble" man then determines its exact nature, and gives orders for remedying it. Thus the telephone operators at the boards are relieved from all such work, and devote their time entirely to answering calls.

To the manager of the exchange room is detailed the task of keeping the books. In the first place, a diary or journal of general information regarding the occurrences of the day is kept. Herein are entered the number of operators reporting for duty, those sick or excused, and any other information of which it is desirable to keep a record, such as a call for an ambulance or police, or a fire alarm, which latter are entered with the exact time received.

In another book, daily account is kept of the number of instruments put in, taken out, or transferred, together with the stamped numbers of the instruments, and the name and address of the various parties. Thus a glance at the book showed that in January 110 connections and 35 disconnections had been made. Similarly, February showed 73 connections and 34 disconnections. A glance at another book shows the total number of subscribers; for as each one is connected, he is entered in regular order with his number. If a subscriber drops out, he is also entered, but in red ink, and instead of adding one to the previous number, it is subtracted. Thus the last number in the book represents the actual number of subscribers.

Still another book keeps account of the number of wires in use. Turning to March 5th, we find this record:—

NUMBER OF WIRES, MARCH 5TH, 1885.

Direct	855
Circuit	84
Pay station	12
Office use	7
Long Island trunks	35
New York trunks	34
Total	1,027

REPORT OF CONNECTIONS MADE AT BROOKLYN CENTRAL OFFICE, SATURDAY, FEBRUARY 21ST, 1885.

Number of Subscribers—1,152. Number of Operators—17 Day, 2 Night.

Hours.	Local connections.	New York City connections.		Local Trunk Connections.						Long Island, New Jersey and New York State Connections.												Total.
				Williamsburg.		Greenpoint.		Bedford.		East New York.		Flushing.		Jamaica.		Astoria.		Babylon.		Far Rockaway.		
		Sent.	Rec'd.	Sent.	Rec'd.	Sent.	Rec'd.	Sent.	Rec'd.	Sent.	Rec'd.	Sent.	Rec'd.	Sent.	Rec'd.	Sent.	Rec'd.	Sent.	Rec'd.	Sent.	Rec'd.	
12 to 6 A.M.	10	...	...	...	1	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	12
6 „ 7 „	7	...	...	...	...	...	1	...	1	...	...	...	...	...	...	...	...	...	...	...	...	9
7 „ 8 „	113	9	...	9	14	1	3	3	...	...	...	...	...	...	...	...	...	...	...	...	...	152
8 „ 9 „	326	18	22	40	31	4	1	11	2	1	4	...	...	...	...	...	...	...	...	...	...	460
9 „ 10 „	456	58	65	42	55	5	9	4	14	...	1	...	...	...	...	...	...	...	...	...	...	709
10 „ 11 „	399	58	75	37	49	6	4	7	10	1	...	1	...	...	...	...	...	...	...	...	...	647
11 „ 12 M.	370	59	72	36	44	6	7	3	7	1	1	...	...	...	...	...	...	...	...	...	...	600
12 „ 1 P.M.	274	42	55	41	40	3	1	4	2	1	1	...	...	1	...	1	...	...	1	...	...	467
1 „ 2 „	259	62	50	49	50	6	8	3	10	...	...	...	...	...	...	...	...	...	...	...	...	497
2 „ 3 „	295	55	66	33	36	3	3	1	3	...	...	...	...	...	...	...	...	...	...	...	...	495
3 „ 4 „	267	43	48	35	34	6	5	4	7	...	...	...	...	...	...	...	...	...	...	...	...	449
4 „ 5 „	219	43	50	45	30	3	3	8	4	...	1	...	...	...	...	...	...	...	...	...	...	400
5 „ 6 „	166	9	14	23	27	5	2	4	5	2	1	...	...	...	...	...	...	...	...	...	1	259
6 „ 8 „	204	10	5	16	30	2	2	8	4	...	...	...	...	...	...	...	...	...	...	...	...	281
8 „ 10 „	125	5	5	16	13	1	1	3	6	...	...	...	...	...	...	...	...	...	...	...	...	175
10 „ 12 „	27	3	2	7	10	2	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	53
Total.........	3,517	474	529	429	464	53	51	65	75	6	9	1	...	1	...	1	...	...	1	...	1	5,677

One of the principal methods of ascertaining the business of the exchange is the system of making a complete record of every call and connection during 24 hours, once every week. These are not all made on the same week-day, but in rotation, so that the business of each individual day can be arrived at. The accompanying table will convey the idea better than any description of the process. Each operator, as she receives a call, makes a note of it on a slip of paper specially provided, using one slip for every call. At the end of each hour the slips are gathered and counted, those from each switch-board being kept separate. This form, when properly kept, shows at a glance the character and extent of the business of the exchange, gives a good means of judging of the requirements to meet the demands, and forms a definite basis of estimate. The figures which appear on the table give the number of actual connections; in addition to this, however, a record is also kept of the "misconnections," as they are called. By misconnection is meant the failure of the calling party to communicate with the other, no matter what the cause may be. These figures do not appear on our table; but in the real form, of which it is a copy, they are added in the same columns as the others, but in red ink and in smaller figures. Thus, in the present instance, 333 misconnections were reported during the day, making in all a little less than 6 per cent. The table also shows at a glance the business from hour to hour, and from each station, and, although not given here, the number of calls on each switch-board is also ascertained by counting the slips from each as stated above.

These constitute the principal accounts kept, but the linemen are also greatly aided by diagrams showing all the principal poles and cross-arms. Each pin is numbered and above it in pencil the number of the wire is placed. Pencil marks are used in this case, because although the pin number remains constant, the number of the wire may change at any time. With these pole diagrams any "cross" can be readily located and trouble quickly removed. In addition to this all linemen are provided with blank forms which give in detail all the material used and time expended upon any work. These blanks when filled out are returned to the central office, the amounts charged up and the blanks filed.

Our limited space necessarily compels us to pass over other small matters that help to produce such good results, but from what has been noted our readers will get a fair idea of how an exchange ought to be conducted. We may add that Mr. Sargent has introduced this system into all the exchanges under his control, and the result is that by merely referring to the proper book he can at any time see the condition of the large system under his charge.

The number of subscribers which can be put in direct communication with one another exceeds 12,000.

Trenton, N. J., presents the outside limit of the territory at present, and although more than 60 miles from Brooklyn, with the line passing through more than three miles of cable, we were enabled to carry on conversation very satisfactorily from Brooklyn with that city.

The cables referred to carry all the trunk lines to New York and pass over the Brooklyn Bridge, being laid between the car tracks, below the foot-walk.

Considering the fact that, at the last meeting of the National Telephone Exchange Association, statistics were available from only 50,000 out of 150,000 subscribers in this country, the above details from one exchange speak well for the care and intelligence bestowed upon it by its managers.

Recognition of Telegraphic Energy.—A provincial contemporary is responsible for the statement that on the occasion of the recent disaster at Shoeburyness the local postmaster and his staff received a letter of congratulation from Mr. Shaw-Lefevre, and a handsome gratuity for extra telegraphic work.

EXPERIMENTAL RESEARCHES ON THE ELECTRIC EXCITABILITY OF THE BRAIN, PROPERLY SO-CALLED.

By M. VULPIAN.

Since the researches of MM. Fritsch and Hitzig, published in 1870, and the results of which have been confirmed by a great number of experimentalists, physiologists admit, almost unanimously, that the grey external layer of the cerebral convolutions contains functional centres distinct from each other. In certain of these centres the volitions are transformed into motive incitations, and they are hence called motor centres, or psychomotor centres.

Before 1870, it was held as a verity irrevocably proved by experiment that the brain, properly speaking, both the grey and the white matter, is entirely and everywhere insensible to all the excitations, mechanical, chemical or physical, to which it is submitted during life, and that none of its points, whether superficial or profound, is endowed with sensibility or mobility. Contrary to these data Fritsch and Hitzig discovered that if a galvanic current is passed through the cerebral substance, by applying the exciters to the surface of certain definite points in one of the cerebral hemispheres, movements are induced in the limbs or in the face on the opposite side; it is the same if we apply as Prof. Ferrier proposed, interrupted Faradic currents. Every other kind of excitement remains without effect of this kind. The movements thus provoked are always the same, if we excite the same region of the brain surface, and they vary in a certain measure as regards the muscles brought into action in such or such a limb, or in the face, or in the neck, &c., according as we electrify such or such a point of the region where there admittedly exists a centre of motive cerebration for any of these parts. The regions whose excitement determines movements in the anterior and the posterior limb of one side are situate in dogs in the posterior part of the sigmoid gyrus of the other side. There are thus two cortical motive centres; the one placed at the front of this part of the gyrus is the motive centre of the anterior limb; the other, placed behind, is the motive centre of the posterior limb.

The experiments of Fritsch, Hitzig, Ferrier, &c., are confirmed by those of Carville and Duret; these experimentators show that the excision of the cortical substance of the regions considered as motive centres involves the more or less complete paralysis of the parts which are set in motion by exciting these regions.

The doctrine of cerebral localisations seems henceforth firmly established on an experimental base, the more as the results obtained with dogs have been confirmed with other mammiferous animals, and especially with apes. The clinical researches of M. Charcot show that destructive unilateral injuries of those regions of the cortical substance which, in man, correspond to the regions considered as motors in apes, produce, on the opposite side, according to their position, paralysis of the motion of a limb, or of both limbs, or of the face.

The experimental proofs upon which is founded the doctrine of cerebral localisation is, therefore, of two orders: the one furnished by the motor effects of electrification of certain regions of the brain surface, the other by the consequences of the removal or the destruction of these regions. I shall speak merely of the first order of proofs, considering simply the experiments upon dogs.

In order that electrification of the surface of an excitable region of the brain may serve to demonstrate that the grey cortical substance, at this point, constitutes the motive centre of such or such part of the body it must necessarily be established that the movements produced in this part are due to the electric excitement of the grey cortical layer itself, and not to that of the subjacent white substance.

At the level of the points where the electrification of the brain surface provokes movements of the limbs, of the face, &c., it has been found that the bundles of nerve fibres, excitable by means of electricity, and by no other agency, issue from the cortical layer of the brain and go directly to the corresponding cerebral peduncle traversing the oval centre of vieussens and the internal capsule. These fibres in the cortical substance are evidently at a slight distance from the cerebral surface, and we conceive that an excitement of this surface, however feeble, might reach them and set them in functional activity. We can only be fully justified in affirming that the effects of the electrification of the excitable regions of the brain have really as their cause the excitement of the grey cortical substance itself if these effects offer, in this case, characters distinct from those of the results of the direct electrification of the subjacent nerve fibres.

It is alleged that such is the case, *i.e.*, that there are notable differences between the effects produced, according as the electrification is applied to the surface of the regions called motive centres, or to the fibres of the oval centre which comes from these regions.

One of these differences is said to consist in the fact that the cortical layer of the brain in the motive regions is more excitable than the nervous fibres which issue from it. This is in fact what is observed if we place ourselves in the same experimental conditions as the physiologists who have observed this difference. It has been noted what is, for the Faradic current employed, the minimum of intensity sufficient to obtain a movement in any part of the body, *e.g.*, in the posterior limb, on electrifying the region in which the motive centre of this member is seated. This region of the cortical substance has then been removed by excision; then, when the bleeding has ceased, faradisation is applied on the surface of the section of the oval centre, to the white excitable bundles which have been cut across. We see, then, that it is necessary, in order to obtain the same movement of the posterior limb, to employ a current a little more intense.

This difference, if incontestable, would have a certain value in the discussion. I must say that it exists only in the conditions in question, conditions in certainty very defective, since the section which uncovers the excitable white bundles of the oval centre of vieussens diminishes the excitability of these bundles, in consequence of the traumatic disturbance and the loss of blood. In order to compare this excitability to that of the surface of the regions known as motive centres, I make use, as I have indicated in a former publication, of a copper wire, covered with gutta percha, and bare at its free extremity only. This wire, which is connected to one of the conductors of the chariot apparatus of Du Bois Reymond, is introduced into the white substance, through the circumvolution which forms the external border of the sigmoid gyrus. It is then let penetrate obliquely below the gyrus, till its free extremity is in contact with the white bundles which spring from the cortical regions considered as the motive centres of the limbs. The other excitor is then placed in a nostril, or in the cavity of the mouth. If we operate thus upon a dog slightly morphinised, or not having undergone any preliminary intoxication, we easily recognise, after having discovered what is the minimum of electric intensity sufficient to provoke movements, by acting on the surface of the gyrus, that the white subjacent bundles may be set in action by a much more feeble current. With Gaiffe's large-model chariot, on placing upon the gyrus (at the level of the point corresponding to the hind limb) the exciter intended to electrify the brain, we still obtain, in an experiment, movements of this limb when the coil of induced wire was placed at 0·175 metre from the point where it entirely covers the coil of inductor wire; at 0·180 metre there is no longer any movement. When the same investigation was made by introducing the same exciter into the oval centre of vieussens up to contact with the white bundle coming from the point of the gyrus in relation with the hind limb, we still obtain movements of this limb when the coil of induced wire was placed as far as 0·210 metre from its point of departure. Further, with a removal of the coil of induced wire to 0·140 metre, the movements occasioned in the posterior limb were less considerable on exciting the surface of the sigmoid gyrus than on electrifying at a distance of 0·190 metre, the white bundle which issues thence.

The excitability of the surface of the sigmoid gyrus is then feebler than that of the excitable parts of the oval centre of vieussens.

Another difference has been pointed out, certainly more important. The electric excitement of the surface of the excitable points of the brain, if sufficiently energetic and prolonged, often induces—as is known from the experiments of Fritsch and Hitzig—epileptiform attacks. It is thus at least with several mammals, especially the dog, the cat, and the ape. These attacks, the characters of which are well known to all physiologists, are only produced, it has been said, by excitement of the surface of the excitable points; they have never taken place when the same excitement is applied to the white bundles issuing from these points. Such a difference would be very fit to show that excitements applied to the surface of the brain really act by setting in activity the grey cortical substance, and not the subjacent white matter. It would at the same time prove that the grey substance at the level of the superficial points excited possesses an impressionability and reactivity, and consequently, as a more or less legitimate inference, that it is endowed with special functional energies. But here, again, we may easily convince ourselves that this difference does not exist. If we electrify the white bundles which issue from the excitable points of the sigmoid gyrus in a dog, conducting the experiment by the procedure above-described, there is always induced an epileptiform attack, violent, prolonged, offering all the characteristic phases, and often followed after a short interval, without any new excitation, with one or several attacks, similar or nearly so to the first. In order to determine the epileptiform attack by the excitement of these bundles, a less strong current suffices than that which is necessary when the surface of the gyrus is electrified. I add that the attack may be produced by the electrification of these bundles, even when all the grey cortical substance of the excitable regions of the brain has been previously destroyed by means of the thermo-cautery.

The other alleged differences between the superficial and the deeper excitations of the brain with reference to these effects are explicable, for the most part, by the greater excitability of the bundles which issue from the points of the grey cortical substance known as motive centres, and by the fact that these bundles are more energetically excited when the electrification bears directly upon them, than when it reaches them across the grey cortical substance.

I consider myself, in fine, authorised in declaring that the experimental arguments, by means of which it has been sought to prove the motive excitability of the grey cortical substance, in certain definite points are void of value, and cannot serve to uphold the hypothesis of the localisation of cerebral functions.

It is important to point out, in conclusion, that the nervous fibres destined to carry the cerebral motor incitements to such or such a part, *e.g.*, to a limb, may spring from the cortical substance at given point. But it does not follow that this point is a distinct centre for setting these fibres in action.—*Comptes Rendus, March 23rd*, 1885.

The Electric Lighting of the Suez Canal.—In the report of the International Commission of the Suez Canal attention is drawn to the important question of night navigation in the canal by means of the electric light. This subject is said to be under serious consideration, experiments having been made with the electric light between Suez and Ismailia; but it happened unfortunately that a bright moon was shining on the night when these experiments were made, the result being that the effect of the electric light was lessened.

MANCE'S PATENT FAULT-TESTING APPARATUS.

THE accurate localisation of faults in submarine cables is a matter of great importance to those who have to undertake the repairs of the defects. It is only those who have had to make the necessary tests who thoroughly appreciate the numerous practical difficulties which arise and who would recognise the value of any contrivances which would render the work easier of execution and more likely to be accurate. Perhaps no one has given more attention to the subject of fault-testing than Mr. Mance; and the apparatus which he has designed for the purpose is the result of extended experience.

The general appearance of the instrument is shown by fig. 5, and the plan of the connections, &c., by figs. 1, 2, 3 and 4. The general explanation of the invention is as follows:—

The effects of earth currents can be eliminated when measuring a perfect line by testing by what is called the "cable current zero method," in which the earth current deflection is adopted as the zero; or by making two measurements, one with a negative and the other with a positive current, the mean result being afterwards corrected by means of well-known formulæ; but *should there be any faults on the line capable of being polarised*, or if the terminal earth or earths be extremely small, polarisation currents are instantaneously set up which oppose the testing current and which have the effect of making the results higher than the real resistance of the line. Reversing the current under such circumstances is useless, as instead of one observation being higher and the other lower than the true value, as would be the case if an earth current merely were disturbing the tests, the tendency of the polarisation current is to make both observations much higher than the true value; moreover, the condition of the fault itself varies considerably under reversals of current thus introducing another source of error; under these circumstances the application of any correction becomes impossible. On the other hand, the "cable current zero method" is open to the objection that, as polarisation currents are set up instantaneously, the earth current zero is altered immediately the testing current is applied. The rush of current into a cable, on first applying a battery, also seriously affects the accuracy of this method, which at the same time requires the exercise of considerable dexterity and skill on the part of the observer.

The modification in the testing bridge (that is to say, the substitution of proportion coils which are more suitable for rapid manipulation), enables tests to be taken by comparatively inexperienced observers, which, when corrected by the formula given in this article, give a result representing the actual resistance tested through, a very different thing from the *apparent* resistance shown by tests taken in the ordinary manner.

The existence of polarisation and earth currents will cause the tests taken from day to day (or with different battery powers) to be widely divergent, but the application of the formula here provided, to tests taken with the improved testing apparatus, will give corrected results closely agreeing with each other, or if the fault is not steady, showing clearly to what extent the resistance due to the fault itself is altering.

Take, for instance, a telegraph cable having a resistance of 6 ohms per mile, with a short length of the copper conductor exposed at a complete fracture 50 miles distant.

This tested daily with the ordinary Wheatstone's bridge and using the $\frac{1000}{1000}$ pair of coils in the ordinary proportion box, may easily give results as widely divergent as 350,400 or even more ohms, whereas the true resistance up to and through such a fault would be about 310 ohms. Up to the present, with a fault of this description, it has been necessary to bring considerable judgment and skill to bear in order to guess at the probable error due to earth and polarisation currents, but by testing in accordance with the following method the corrected results in such a case as that above quoted would have been about 310 daily, that is to say, 300 for the line and 10 for the fault; one pair of readings will give a sufficiently correct result and long series of tests will be unnecessary.

The daily variation in the *corrected results* is usually so small that the occurrence of a second break in the vicinity of the original fault is frequently detected, whereas with the old system of testing its existence would have been unsuspected in consequence of the slight difference being unnoticed amidst the variations caused by changing earth and polarisation currents.

In testing a closed circuit, free from any disturbing currents, the result will appear the same whether testing with a pair of proportion coils having a resistance of 100 ohms each or whether using a pair having a resistance, say ten times as great.

But let there be any disturbing influences such as polarisation currents, and the result observed when using the smaller pair of coils in the proportion box will be quite different from those obtained when using the larger.

In determining these differences accurately much depends upon being able while testing *to quickly substitute one set of proportion coils for another* and to rapidly readjust the resistance in the main branch (the 10,000 box) so as to reproduce balance.

Using the ordinary Wheatstone bridge arrangement with the improved switching proportion coils, the observer should apply a continuous current when testing a fault, and observe the apparent resistance, using, say, a pair of coils in the proportion box of 100 ohms each. Having observed the resistance (without taking the current off) switch the pair of proportion coils out of circuit, substituting almost instantaneously a pair of a different value (by preference commence by using a pair of 100 ohms each and then substituting a pair having a resistance of 1,000 ohms each). With the second pair of coils in circuit readjust the resistance in the main branch till balance is again obtained —this can be done very rapidly by using in the latter branch a sliding resistance box containing 50 or 100 coils of one ohm each for the finer adjustments.

In testing by this method, the second reading (that is to say the one obtained when using the higher pair of proportion coils) is usually higher than the first when using the lower pair of proportion coils—but not invariably so. The first reading may be taken leisurely—the second should be secured with as little delay as possible to avoid any error due to alteration in earth or polarisation currents between the observations. The improved proportion coils and the sliding resistance of single ohms enable even an inexperienced observer to secure very accurate results.

Method of calculating the tests.

The results obtained by using different pairs of proportion coils provide equations which enable us to eliminate the effects of the polarisation or earth currents.

Let P_1 equal the resistance of one of the proportion coils used during the first observation, it being assumed that the test is commenced with the lower pair of coils.

Let P_2 equal resistance of one of the higher pair used to obtain second observation.

If using the hundred to hundred and thousand to thousand pairs,

P_1 would equal 100.
P_2 „ „ 1000.

Let R_1 = resistance observed when using P_1 proportion coils.
Let R_2 = resistance observed when using P_2
Let r = the internal resistance of the testing battery.

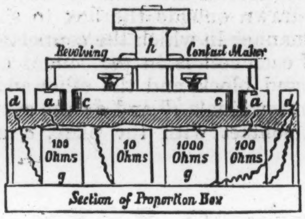
Then x, the true resistance of the line and fault tested through,

$$\text{equals } \frac{R_1 (2r + P_2) - R_2 (2r + P_1)}{P_2 + R_2 - P_1 - R_1}$$

When tests from both sides are available and the conductor is *unbroken*, the resistance of the fault is immaterial providing it remains steady—its position can be ascertained by means of tests taken with the distant end of the cable earthed or insulated; but before any of the customary formula (as, for instance, Blavier's) are applied, the tests, both insulation and earth, *must first be corrected by the foregoing formula.* Additional accuracy will be secured if, when testing from both sides, the fault is brought approximately near the centre of the line by inserting resistance on the shorter side and treating this added resistance as part of the line for the time being; it is better also if the batteries on either side be approximately equal in strength.

If the cable is completely fractured, the copper conductor is almost invariably exposed on one side of the break—as a general rule at least half an inch is in contact with the water. A good idea as to the size of the fault can be formed from the steadiness or otherwise of the tests. If there is little or no tendency in the fault to increase in resistance when tested with a positive current, it may safely be concluded that it is a large one, for which 10 ohms will, as a general rule, be a fair allowance; by deducting this amount from the corrected results of tests to the broken end and dividing the remainder by the conductor resistance per knot, the distance up to the fault will be given without any further calculation being necessary.

FIG. 2.



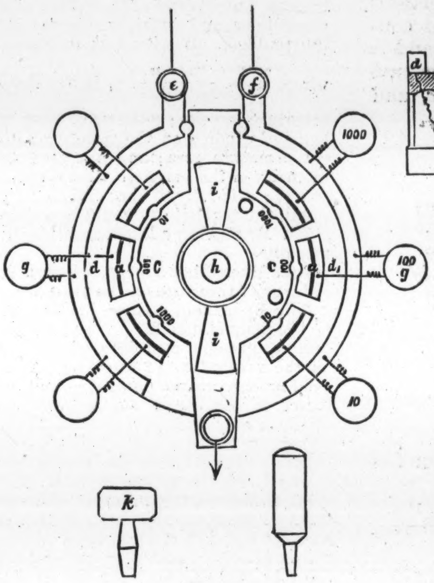


FIG. 1.

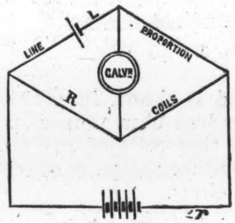


FIG 3.

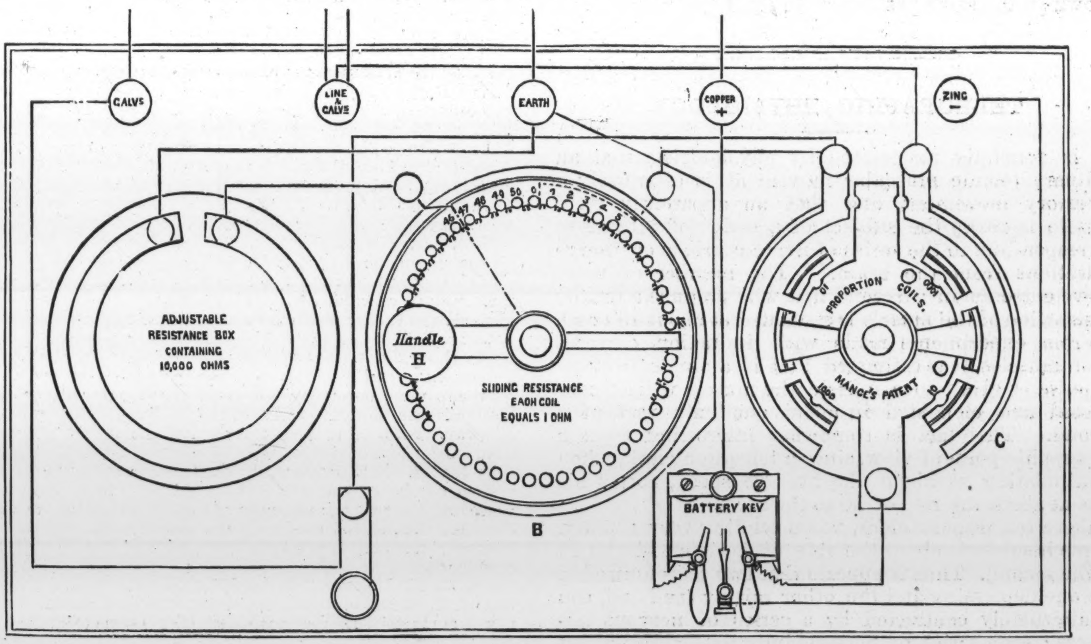


FIG. 4.

The general arrangement of the apparatus, as before stated, is shown by figs. 1, 2, 3 and 4 (the galvanometer and battery being omitted). R is the main resistance, adjustable up to 10,000 ohms. In direct connection with it and practically forming part of it is the additional box, B, containing any convenient number of coils of small resistance (generally 1 ohm each will be found most convenient) with sliding contacts for rapidly effecting the finer adjustments: these coils are thrown in or out of circuit by turning the handle, H.

The improved proportion box, C, fig. 4, permits of the various pairs of coils being instantaneously changed by giving a movement of rotation to the handle operating the double arm, *i*. It can be used in the ordinary manner with equal or unequal proportions by placing the handle at zero, as in fig. 1, and inserting two metal plugs, K, at the holes pertaining to the coils it is required to use. The proportion coils may be short circuited, if required, by placing these two plugs in the two extra holes near the terminals, *e* and *f*. Two stops are provided for limiting the play of the arm *i* when working by "Mance's method"; these stops can be placed in holes conveniently placed about the brass plate, *c*.

The limb or arm, *i*, is furnished with platinum contact edges or points to ensure perfect contact, they rubbing on platinum surfaces in the metal blocks, *a*, *a*. In fig. 1 the coils are drawn outside the box to show diagrammatically the manner in which the connections are made. One end of each coil is in permanent connection with its insulated block, and the other end is brought to the common terminals, d^1 and *d*; the arm, *i*, is in perfect metallic contact with the plate, *c*, and terminal, *b*.

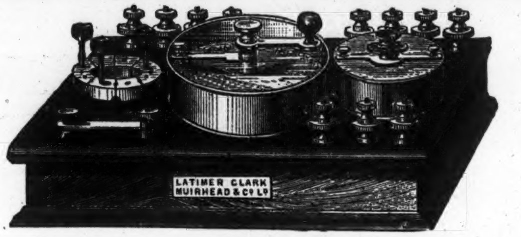


FIG. 5.

At C, in fig. 4, the arm, *i*, is shown in position for throwing a pair of one hundred ohm proportion coils into circuit—it is obvious that coils of any required resistance may be substituted for the pairs of ten—one hundred and one thousand ohms.

Fig. 2 is a section of the improved arrangement for manipulating the proportion coils. The arm, *i*, is shown in the same position as in fig. 4.

TELEGRAPHIC PHYSIOLOGY.

IT is generally understood by physiologists that an ordinary tetanic muscular movement is essentially a vibratory movement, and that an apparently rigid muscle is really the subject of a series of vibrations corresponding to the series of nerve currents or "nerve pulsations from the brain." The number of these nerve currents in a second that will produce a tetanic contraction of the muscle is estimated at about 19 or 20.

From experiments made with induction currents upon muscles, it is estimated that if a single nervous impulse is given to a muscle, the muscle will be contracted and elongated in about one-tenth part of a second. This fact is somewhat interesting from a telegraphic point of view, since a telegraph clerk, when manipulating at about the average speed, forms his dots at about the rate of 10 to the second.

But a telegraphic clerk, when sending very rapidly, forms his dots at about the rate of between 14 and 15 to the second. Thus it appears that two sets of muscles, the one depressing and the other raising the hand, can be alternately contracted by a series of nervous impulses; each series of nervous impulses having about three-fourths the rapidity that would be required to produce a tetanic contraction of the muscles.

In writing, the rapidity with which a muscle may repeat a motion in the same direction is possibly less than 10 times a second—thus, for instance, a pen could not make 10 down strokes in a second.

The less frequent contraction of the muscles in writing than in telegraphic manipulation is probably accountable by the greater complexity of the motion of the hand in writing than in telegraphic manipulation.

W. MOON.

ELECTRIC LIGHTING FOR STEAMSHIPS.*

By ANDREW JAMIESON, Assoc. M. Inst. C.E. and F.R.S.E.

(Continued from page 333.)

CORRESPONDENCE.

Mr. R. E. CROMPTON remarked that the question of low speed dynamos for ships had excited the greatest interest amongst the manufacturers of these machines, and great progress had been made. The author had given little information on this point, stating merely that several of the best forms of dynamo had been modified for ships' use. Up to a recent period, this modification, as usually carried out, consisted in winding on to the armature an increased number of coils, making a large machine do the work of a small one, and certainly this was not a scientific mode of solving the problem. If, when put into the form of a simple formula, where $E_a = \frac{r\,n\,a\,\mu}{1,000,000}$, E_a being the electromotive force in the armature in volts; *r* the revolutions per minute; *n* the number of turns of winding on the armature; *a* the area of cross section of the armature core; and μ a coefficient which depended on the intensity of the magnetic field through which the turns of wire *n* passed; evidently, if the revolutions per minute were to be kept small, the requisite E_a would be obtained:—

1st. By making *a* large, and this involved a large and expensive machine.

2nd. By making *n* large, which meant winding a great number of turns of thin wire on the armature.

3rd. By making μ large, in other words increasing the strength of the magnetic field.

Now, up to a recent date, whenever sea-going engineers insisted on the revolutions of the dynamos being kept down to five hundred revolutions per minute, so that the dynamos could be coupled direct to the steam engines which drove them, the first two methods only were employed. It remained for Dr. Hopkinson, and in a lesser degree for himself, to obtain the necessary electromotive force at the required low speed, by increasing the strength of the magnetic field. This had been arrived at by them independently in much the same way, viz., by using, both for field magnets and for the armature core, a greatly increased mass of the softest and purest charcoal iron, and proportioning the parts composing the magnetic circuit so as to obtain the least possible resistance to the passage of the lines of force. This improvement in dynamo apparatus enabled machines to be constructed giving sufficient electromotive force for working the lamps at the comparatively low speed of 400 revolutions per minute, and still to maintain a high efficiency or high proportion of useful output; whereas by the older plan of increasing the turns on the armature, the efficiency of some of the machines used in the Royal Navy and elsewhere was only as much as 50 or 55 per cent. In the later improved machines the efficiency was as high as 84 per cent. at the same number of revolutions. He did not like to let the author's electric governor pass unnoticed. It was stated in the paper that a good electric governor was greatly to be desired, and the author spoke of attempting to solve the problem, as if it had not already been solved. This was a mistake. Mr. Willans, the inventor of the three-cylinder engine, Mr. Wilson Hartnell, the inventor of the bell-cranked governor, and he had been working jointly at the subject of electrical governors for a considerable period. Nearly a year ago Mr. Willans succeeded in making an electrical governor which gave all the results which the author asked for, and this identical governor had, to the best of his belief, been practically working up to the present. Since then they had introduced various improvements, and had 46 of these governors at work. Two of them were governing the two large engines at the electric station at the Victoria Station of the London, Chatham and Dover Railway. Each of these governors had the task of governing a compound steam engine, capable of working up to 350 H.P. when fully loaded. It maintained the electromotive force of the entire system nearly constant; in fact, it did not admit of a variation exceeding 1 per cent., although the load of the engine varied from 50 to 160 H.P. in the course of the evening. He did not think that any mechanical governor had ever attained this degree of excellence.

Mr. R. E. DUNSTON observed, that as the uncertainty of the electric light had always been one of the most damaging points urged against it, he was surprised that no mention had been made in the paper of the possibly disastrous and certainly annoying results which must follow the fusion of a main safety junction. The arrangement shown by Mr. Hedges had, at all events, the merit of trying to alleviate this evil. This arrangement would prevent a total extinction of light owing to a temporary excess of current in the main if not caused by short circuits; but it would give no indication that it had been called into action, and so the secondary fuse, of large current capacity, might remain in circuit for a considerable time, during which there would be but little protection against undue heating of the wire. He thought that the arrangement adopted by the Pilsen Company, which was not covered by any patent, was more serviceable. It was to place in parallel circuit with the safety fuse a suitable resistance in series with a second safety fuse. In the annexed diagram (fig. 15), M represented the main; M, F, the fuse in series with the main; R the resistance in parallel circuit with the main fuse; and R, F, the fuse in series with this resistance. With this arrangement, as with that of Mr. Hedges, both fuses would act in the event of a dangerous short circuit; but should the main fuse fail owing to a temporary excess of current, then the resistance R, suitably adjusted to the circumstances, would tone down the lamps to half power, thereby attracting the attention of the attendant, and ensuring the renewal of the main fuse. With regard to the sectional area of copper required in leads, and the amount of insulation desirable to place thereon, he should be sorry to advocate false economy; but on the other hand he must enter a protest against rule of thumb. It had been urged that the cost of copper was, relatively to efficiency, but a trifle. To this he dissented for two reasons: first, it was incorrect; secondly, it might have a tendency to check investigation on this important subject, and to cause practical men to revert to the rough rule—"Have copper enough"—from which they were only now beginning to be free.

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* From the Proceedings of the Institution of Civil Engineers.

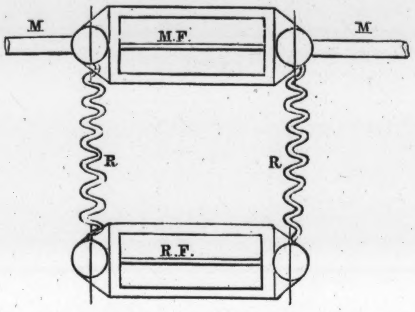

FIG. 15.—PILSEN LIGHT. ARRANGEMENT OF SAFETY FUSE.

Mr. J. F. **FLANNERY** submitted the particulars of the cost of electric lighting on the Birkenhead steamers, upon the basis of which the system was being fitted by the Wallasey Local Board to two saloon river passenger-steamers being built at Preston. The vessels were 130 ft. long, 35 ft. beam, and had about 25 Edison-Swan lamps. In the case of one vessel, the dynamos were driven by Mather and Platt's horizontal engine costing £240, and in the other by Parker and Elwell's 3-cylinder engine, costing £180. The lamps were guaranteed to last 1,000 hours each. The total cost of coal on one steamer for 920 hours was 1¼d. per hour, and oil for the engines came to about 2s. 6d. per week. The cost of the oil and wicks of the old oil lamps was £17 per annum for each boat, and the cost of electric lighting was about £40 per annum for coal and oil; but there was of course no comparison in the amount of illumination, nor as to the general appearance of the saloons under the two systems. It was estimated by the engineer-in-chief of the Guion line that the expense of the electric lighting system was, for maintenance and consumption, about three times as much per vessel as the former system of oil lamps.

Prof. G. **FORBES** observed that the defect of the lamps often going out, when the ship rolled heavily, was due to the spring by which the lamps were attached to the terminals. If the steward in fixing a new lamp did not take care that the pressure of the spring was equable, a heavy roll of the ship overcame the spring and broke temporarily the electric circuit. He lately noticed the same effect in his own cabin on the *Servia*, and the steward was alone to blame. Makers of lamps, however, might take note of the trouble, and arrange matters so that not even the steward could cause this annoyance.

Mr. W. A. **GORMAN** remarked that the author, in concluding the paper, mentioned as a novelty the electric light for fishing and submarine purposes. But since 1870, in conjunction with Messrs. Siemens, Messrs. Siebe and Gorman had manufactured submarine electric lamps.* In the hands of inexperienced men the arc light was not so suitable as a lamp now constructed by them. It consisted of five Swan glow lights, placed in a glass globe made of sufficient strength to withstand the pressure of water. The globe was held in metal flanges; the top flange contained the stuffing-box for the wires, sling handle and weight. The total cost was only £6. Electric light was most valuable for submarine work. A large steamer had been saved in November, 1884, entirely through the divers having a submarine electrical lamp. The work was carried out day and night, and the vessel was floated just before a heavy gale came on. He considered electric light for submarine purposes to be most valuable, and with the aid of the telephone a great assistance to divers when engaged in harbours, or when working in the holds of sunken ships, as also for holding a survey upon a vessel damaged under the water line, frequently obviating the expense of docking.

Mr. C. **HALL**, of the Peninsular and Oriental Steam Navigation Company, was enabled, by favour of his directors, to submit the following statement of the company's experience of the cost of electric light on board ship. He should premise that the statement made by Mr. Farquharson, with reference to the comparative cost of the two systems on board the *Crocodile*, appeared to be incorrect in one important particular; he referred to the depreciation of electric plant. By allowing only 2½ per cent. Mr. Farquharson estimated the "life" of the plant at forty years; but he was much mistaken if ten years' life was not a more trustworthy estimate, looking at the likelihood that all existing plant would be obsolete ten years hence. He had, therefore, reckoned 10 per cent. depreciation on plant, and 5 per cent. on the foundations; while a similar depreciation of 10 per cent. had been allowed for the oil lamps. The electrically lighted ship *Valetta* had been running for nine months, covering during that period nearly 42,000 miles. Her actual cost for lighting was equivalent to the following amounts for a complete year:—

	£	s.	d.
Coil, oil, stores, candles, repairs, lamp renewals, pay and victualling of men ...	664	7	2
Depreciation of plant at 10 per cent., of foundation 5 per cent.	179	5	0
	£843	12	2

In comparison with this he had caused an account to be prepared of the cost of ordinary lighting on board the *Carthage*, a ship of similar type and size, employed on the same East Indian and Australian service.

	£	s.	d.
For one year the cost of lighting by oil and candles (including repairs of lamps) was...	493	13	7
Add 10 per cent. depreciation of lamps ...	70	0	0
	£563	13	7

It would thus be seen that the result was different from that obtained on board the *Crocodile*, where an economy of about £300 a year had resulted from the use of electric light. In the *Valetta* there was a loss of £279 18s. 7d., or 49½ per cent. This was not difficult to explain, the fact being that the *Carthage* and other Peninsular and Oriental steamers were very economically lighted by means of a mineral oil, which was both safe and cheap. The *Crocodile* on the contrary appeared to have been lighted in an expensive way by olive or colza oil and candles. It should be stated that although there were 250 electric lamps on board the *Valetta*, she was not exclusively lighted by electricity; oil lamps were still used by the trimmers in the bunkers, and for cargo purposes in the holds. Some candles were also burned in the officers' cabins, &c., when the ship was lying in port without passengers, it being undesirable to keep steam at such times for the electric light.

On board the *Valetta* was the only specimen which the Peninsular and Oriental Company had of the double-wire system; and it was somewhat curious that she was the only ship in which he had had a case of a cable corroding through the action of salt water. The author seemed to think this defect a special peculiarity of the single wire system; but he could assure him that his observation, so far, led to precisely the opposite view. He had adopted the single wire system with considerable hesitation, the joints between the lamp wires and the skin of the ship being a matter of some anxiety; but his apprehensions on this point had been completely set at rest by the careful way in which these joints had been made by Messrs. Siemens Bros. and Co. He did not share the impression that there was of necessity an increased chance of short circuiting, when the single wire system was used. But, on the contrary, it appeared to him that the single wire system, if properly carried out, was less liable to short circuit than the double system. It was scarcely necessary to point out the advantage of having only one wire to deal with and protect instead of two wires, and the additional gain in the matter of diminished resistance was by no means to be despised. Some fears had arisen at first in the minds of the nautical staff that the compasses would be affected by taking the return through the ship; but after careful and prolonged observation, it had been proved that such fears were groundless. The frictional driving gear of Mr. Raworth had been shown to him on board the *City of Chicago* about twelve months ago, and it at once took his fancy. Four sets were now at work on board ships belonging to the Peninsular and Oriental Company, and the results had been so satisfactory that similar gear would shortly be fitted to several others. The gear was evidently inferior to none in compactness and simplicity; but its greatest recommendation was the way in which the ship's engineers approved of it. Many other small engines were in use on board for various purposes, of the same type as the engine used by Raworth, and the knowledge that these little engines could be, and in fact were, worked from year's end to year's end with little attention, and next to no repairs, enabled duplicate plant to be confidently dispensed with; a few spare parts, including an extra armature, being the only duplication found necessary. The pulleys were solid blocks of paper, made of a pile of sheets, compressed by hydraulic power, and bolted between two wrought-iron flanges. The paper surface was turned up in a lathe like a block of hard wood, and it was so solid that it rung like a piece of metal when struck. He had not yet been able to detect the slightest signs of wear in any of the pulleys under his charge. He had made it a rule to provide a large margin of power in all the installations for which he was responsible; unless this was done, the engine could not perform its work when the piston became leaky, or other derangements incidental to a long voyage occurred. In many cases it seemed as if there was an undefined idea among electricians, that Mr. Preece's proposal to make a H.P. equal to 1,000 watts had become an accomplished fact; but his own practice in this respect was so to proportion the engine, that not more than 400 watts per actual H.P. should be expected when new. He could not say much at present with reference to the life of the incandescent lamps on board ship; the oldest lamp afloat of which he had experience being only about 1,200 hours, but the satisfactory duration of lamps in the Royal Navy would solace the gloomy feelings hitherto inspired by the bills for Swan and Edison lamps. No doubt it would soon come to pass that a Swan lamp would be guaranteed for 1,000 hours, and replaced gratis if it broke sooner. He must confess, however, that in this respect the Swan lamps had not given much cause for complaint, so far as the Peninsular and Oriental Company was concerned. One vessel had just completed a voyage to China and back with only 20 broken lamps out of 250, but the Edison lamps had not been so fortunate. He had had trouble when the plaster became wet, as it often did in the engine room or stoke-hole; the little copper wires which passed through it corroded and parted. However, most of the failures of the Edison lamp left the filaments intact, and it had been possible to cobble up the lamps, and make use of them in many cases. In compliance with urgent demands for deck cargo lights, he had reluctantly been compelled to provide them. The prospect of flexible cables bundled about on deck at the mercy of seamen and stevedores was one which he could not contemplate without misgiving, and he should be thankful for a good practical suggestion for a method of keeping these cables out of harm's way. He considered arc lights to be unsuited for passenger steamers, where it was impossible to give them the same attention as in the Navy. Passenger steamers could not afford to carry a special officer to look after them, and they would soon be destroyed by the combined effect of coal-dust, steam, salt spray, and the rough handling of unskilled men. He had, therefore, contrived a special form of deck lantern to contain three 40-candle Swan lamps. This lantern served for use at the hatchways, at the yard-arms for coaling; and he had suggested its adoption for dances or entertainments on the quarter deck.

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* Minutes of Proceedings, Inst. C.E., vol. lii., p. 85.

For the last two years a good deal of his time, attention, and patience had been absorbed by the care of a large set of storage cells, used for lighting the company's office in Leadenhall Street. The convenience of the system was of course great; light was available at any moment, day or night, irrespective of engine or engine-driver. Every lamp could be switched into circuit whenever wanted, and put out when done with; the latter operation was, he regretted to say, often forgotten. The service of light had never been interrupted for a single day, but this result had been only obtained by an amount of care and watchfulness which could not be expected on board ship. Another objection to storage cells at sea was the quantity of sulphuric acid carried in them; and the danger to an iron or steel ship from the slopping about of this acid needed no comment. The Author seemed to have a high opinion of the value of insulation tests, and he agreed with him that they should be made if the installation was taken at a low price, or was in any way doubtful; but such tests were troublesome to make, and for all practical purposes, he thought, they might be dispensed with, when there was no doubt in the first place that the quality of the cable used was first-class; and in the second place, that the contractors were thoroughly good and responsible people. The contractor would protect himself by employing only good and capable men, if he knew that he would have to make good defects. After all, there was no insulation test so thoroughly searching as practical work at sea for a couple of long voyages. He agreed with the author that a perfect mechanical governor for sea-going electric light engines did not exist; in fact, the present governors were not much used; they caused the light to fluctuate, and the men preferred to work by hand, keeping the governor adjusted to check any large increase of speed, such as would occur if a whole circuit of lamps went out simultaneously. He feared that even the electric governor shown by the author would scarcely overcome the difficulty, seeing that it merely governed the steam supply. Now electrical engines were connected to exhaust into the main condenser at sea, and ran with the regulation open, perhaps, half a turn; the work being mostly done by the vacuum, and it must be evident that, unless the throttle was absolutely steam-tight, the engine would run on the vacuum for some time after the throttle was closed. It was undesirable to put a second throttle into the exhaust, and govern at both ends; but he thought it was possible that something might be done by employing the governor to brake the engines.

Mr. Druitt Halpin remarked that the question as to the consumption of steam in small direct-acting engines having arisen, it might be of interest to give particulars of a test lately undertaken in America with a Westinghouse engine, and published by the *American Machinist*, 29th November, 1884. The engine had two single-acting cylinders, each 7 inches in diameter, by 7 inches length of stroke, and made 293 revolutions per minute, the steam being cut off at half stroke by the lap of the valve. The boiler-pressure was 95 lbs. per square inch, and the clearance 7·2 per cent. The mean effective pressure was 44·13 lbs., and the indicated H.P. 17·54; the brake H.P. being 15·53, or an efficiency of 85 per cent. The steam used per indicated H.P. per hour was 34·36 lbs., and per brake H.P. 38·8 lbs. Of the water used, 80 per cent. was accounted for by the indicator. The grate area was 4·9 square feet, and the heating surface 80·6 square feet. The evaporation to and from 212° Fahrenheit was 9·44 lbs. of water per lb. of coal, and, taking the temperature of the feed at 56° Fahrenheit, this gave a consumption of 5 lbs. of coal per indicated H.P. per hour. With reference to the question of regularity of running of engines driving dynamos, he thought mechanical engineers were often most unjustly blamed by electrical engineers for faults which really did not exist. He had lately seen an installation consisting of several large arc lamps driven from one engine, and he observed that the irregularity in the light took place in each lamp successively. As they were all driven by the same engine, this could not possibly have happened had the driving of the engine been at fault.

Mr. W. H. Massey observed that, although it was the fashion to solder joints, he had found it easier and better in every way to make tight well-bound joints without solder. Copper being such a good conductor of heat, when soldering was resorted to, the insulating material on the cable or lead was spoiled for a longer distance on each side of a large joint than was allowed for in ordidary practice; besides which there was always a much greater chance of injurious matter getting into the joint, even when the use of "killed salts" was forbidden, and so causing chemical action. He had known cases where, after passing a strong current through a circuit for a short time, a kind of secondary battery action could be detected at the joints; and yet these joints and the insulation of leads had been tested, and pronounced very good. What might do very well for submarine cables would not answer for electric light joints, because there might be more electro chemical action during five minutes with the latter than would take place with the former in ten years. He thought it desirable to make some tests, but his experience had been that too much testing made men engaged in jointing careless. In his opinion, it was far more important to establish an insulation that would last well, than to aim at absolute perfection in the first instance. He had been on board ships fitted up by eminent firms, and where the total insulation resistance was not more than two or three times the resistance of an incandescent lamp; and, although less than he should insist on for his own work, these installations might possibly outlast some of those fitted out under the author's rules.

Mr. C. H. Phillips would specially emphasise the author's contention that every installation should be tested and passed by competent electricians, and with such conditions he believed the supervision might be fairly entrusted to the engineer on watch; the author had judicially stated the "for and against" wiring with one lead or two leads; and if he preferred the one wire system, making the iron of the ship earth, he slightly differed with him. As a matter of cost he thought the extra wooden and waterproof casing throughout would more than counterbalance the slight cost and advantage of return wires. He agreed with him that it was most essential to have an ample carrying capacity in the leads, and that for all ordinary lengths on board ship the standard of 1,000 ampères per square inch of copper was sufficient. There had been some difficulty in finding a dielectric to cover all the requirements stipulated for by the author, but he thought they had now been fairly met by the use of high class vulcanised India rubber where gutta percha was almost useless, as it would not stand exposure to the atmosphere. He felt sure the author would agree with him that considerable skill and care were required in running the leads, as they were far more liable to damage on board ship than on shore. The idea of testing "air leading wires" in salt water, after 24 hours' submersion, was a great innovation upon the empirical ways in which too many installations had led to failure.

Mr. A. Jamieson, in reply to the discussion and correspondence, said he agreed with Dr. Hopkinson that if the absolute insulation resistance of dynamos was carried out in inverse proportion to their size or conductor-surfaces, an equal degree of efficiency and safety would result; and he would therefore modify his rather hard-and-fast rule, thus:—"New dynamos for 100 incandescent lamps to be tested immediately after a run of not less than one hour at full power, and to have an insulation-resistance of not less than 10,000 ohms per volt generated by them, between the metal frame work and the armature with electro-magnet coils in circuit, as well as between the series and shunt wires of the electro-magnets. The insulation resistance of other sizes to be in inverse proportion to the number of lamps they work, *e.g.*, a 200-light dynamo to have 5,000 ohms per volt generated under the above circumstances." He had found by experience that it was advisable in electrical work, not to state vaguely that the insulation-resistance was to be "good," or "perfect," as these words were variously interpreted, but rather to fix upon an amount of insulation which could be attained in practice with due precautions, and which would at the same time ensure a good margin for deterioration. Great care should be taken that all crevices, corners, and surfaces between the conductor and the cores, or frame work, should be filled up with some good insulating substance impervious to damp, such as vulcanised fibre and Scott's insulating varnish, to prevent as far as possible the lodgement of damp from steam, water, as well as oil and dirt, which, more especially on board ship, sooner or later find out weak points in the dielectric, and had so frequently given trouble. He had found it necessary in certain instances to cover in the dynamo with a metal casing to prevent the water from main engine cranks splashing over it, and thus destroying the insulation.

In a similar way the rule stated by the author for the absolute insulation resistance of the leading wires, &c., might be thus modified:—"The insulation resistance of each set of circuits amounting to 100 lamps, including the switches and cut-outs, to be not less than 1,000 ohms per volt generated by the dynamo at the normal speed.* The insulation resistance for any other number of lamps to be in inverse proportion to the above amount: *e.g.*, the whole of the leading wire circuits put together for a ship having 200 lamps to have not less than 500 ohms per volt." As instances that there was no difficulty in surpassing the above requirements, he had found, in taking final tests on a damp day on board the ss. *Arawa*, where there were 300 (100-volt) lamps, that the absolute insulation resistance of the whole leading wire system throughout the ship, including the branch and single switches, &c. (lamps left out), amounted to 102,500 ohms, or 30·75 megohms per lamp; and the copper resistance of the longest section on board from the dynamo to the furthest lamp was only 0·29 ohm.* The above results were accomplished by care in the fitting and jointing on the part of Messrs. William Denny and Brothers' electrical staff, and by using first-class material throughout, and applying frequent searching electrical tests during the insertion of the wires and fittings, without which in the author's opinion good and lasting work could not be always obtained.

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* Equivalent to 10 megohms per lamp of 100 volts.

It might be mentioned that the contractors for the wire will guarantee an insulation resistance of 100 megohms per 1,000 yards for the class of wire used in this instance (viz., best vulcanised India rubber covered wire, type D), after 24 hours immersion in salt water at 60° Fahrenheit. This wire would suit Mr. Albright's requirements for masthead lights, and if properly embedded in deeply grooved wooden cases well covered with the putty white-lead composition mentioned by Mr. Farquharson, and wooden tops to the casings, it should withstand all the trying effects of the stoke-hole.

The author was glad to find from the remarks of Mr. Preece, Mr. Swan, Mr. Phillips and others, that the necessity for good insulation in electric light systems was beginning to be generally appreciated, as from his early training in connection with submarine cables he had been one of its first and strongest advocates. No doubt, as Mr. Hall remarked, practical work at sea for a couple of long voyages was a thorough test of insulation; but what firm would wait for such a long and protracted test as that if, by the application of proper appliances and rules, the value of the materials and of the installation generally could be determined before the vessel started on her first voyage.

In regard to the several opinions expressed about the size of conductors which he had proposed, the adoption of a larger cross area would in no way lessen the necessity for an equally good quality and thickness of dielectric, the electromotive force being the same, and consequently the first cost and expense of fitting up larger leads would be in a greater ratio than the increased size of conductor. The sizes adopted by him were larger than most contractors had been in the habit of using. The rise of temperature above surroundings due to electrical heating was, even for the largest wires required, under 10° Fahrenheit. The fall in potential along 100 yards of the conductor was only 2·5 volts with the full normal current, and as the leading wires were seldom of that length, except to the forecastle and steerage, or second-class passengers' quarters, the slight difference between the light of lamps closer to the dynamos and those at the further places was not so much as that due to the discrepancy between the lamps themselves, as pointed out by Mr. Siemens in reply to Mr. Preece.

The rise in potential, when all the lamps but one of a section were turned out, under the circumstance mentioned by Professor Perry, only affected the lamps in proportion to their distance from the dynamo, and for the above mentioned reasons it was not worth while in the case of ships to prevent it "by lavishness in the cost of the copper cable." The percentage waste of energy, due to the heating of the conductor, was only 2·6 per cent. of the power being conveyed by the conductor for every 100 yards of its length. The annual cost of power wasted in heating the conductor at £10 per I.H.P. balanced the yearly interest at 5 per cent. on the prime cost, plus depreciation at 5 per cent., plus interest at 5 per cent. for the best class of vulcanised India-rubber covered copper conductors, in the case of a ship trading between England and India. The author's rule and table fitted in well with the usual sizes kept in stock by manufacturers, and with the most approved method of grouping the sections under the control of main switches into 20 and 25 lamps, as well as for subjections into 10 lamps or less. In very large ships with leads over 100 yards in length and for the double-wire system, the sizes might advantageously be increased to 1 square millimetre per ampère instead of 1½ ampère, but in no case was there any necessity for going beyond this on board ship.

In reply to Mr. Mance as to whether the 150 ships already fitted with the electric light still use it, he had only heard of one case in which it had been discontinued, and that was where the attempt was made to drive the dynamos direct from the marine engines. The general tendency was rather to extend it in those ships which had only at first been partially lighted. In electric lighting, the unit of length fell from knots to yards, and the estimate of insulation resistance correspondingly fell from megohms to ohms! The joints mentioned by Mr. Mance were the best for electric lighting, and were those which the author had insisted upon in his specifications.†

The balance sheets and statements made by Messrs. Farquharson, Hall, and Flannery, respecting the cost and up-keep, as well as life of, incandescent lamps on board ship were most interesting and instructive. The estimate by the engineer-in-chief of the Guion line that the cost of the electric light system for maintenance and consumption was about three times as much per vessel as the former system of oil lamps, could only be accounted for on the assumption that that well-known line was sparely supplied with oil lamps and lavishly supplied with the electric light, and was now making up for former deficiencies. Mr. Hall had apparently omitted to add the pay and victualling of men attending to oil lamps and candles, which would make the difference between the two systems of lighting still less in the cases quoted by him. No one gave the first cost of a complete installation. He had found that lately an installation on the double-wire system with direct driven dynamos at 500 revolutions per minute, costs on an average for 50 lamps £400, for 100 lamps £700, for 200 lamps £1,200, and for 300 lamps £1,500. On the single-wire system the estimate was 5 to 10 per cent. cheaper, and with leave to run the dynamos at 1,000 revolutions or more per minute, and any ordinary vertical or horizontal engine, the estimate was 10 per cent. cheaper still. No doubt these prices would be still further reduced, for they had been much higher in the beginning of this rapidly progressing industry. Of course it must be borne in mind that the above estimates were only for plain durable fittings, and did not refer to highly artistic chandeliers, or heavily gilt or electro-plated brackets.

The battle of the "single-wire" *versus* the "double-wire" system had been so well fought, that the author felt he could not do better than refer the advocates of the latter system to Mr. Hall's practical remarks in the Correspondence. An equal number of ships had been fitted, under the author's inspection, on both systems, and he was bound to confess that when the work was thoroughly well done throughout, and the dynamos thoroughly well insulated internally, and if possible from the earth, the single wire system was the cheapest, the simplest, and the best on board ship. As regards the facility for accurately localising the position of faults, with the meagre testing appliances usually placed on board ship, the one system afforded no advantages over the other. The only warning that the attendant had in either case was the giving way of a fusible wire or cut-out; and if these were judiciously arranged in each section and sub-section, and, if preferred, at each lamp as well as in the dynamo itself, there need be no fear of any serious breakdown for more than a few minutes.

In regard to joints, he was astonished to find Mr. Massey asserting that "he had found it easier and better in every way to make tight, well-bound joints without solder." He would, no doubt, find it easier, but certainly not better. The author could point to an instance in which "bound joints" had cost a contractor a very large sum of money to replace by well-soldered joints. Joints should not be soldered with "killed salts," but with rosin, for if killed salts were used the whole of the joints would, to a certainty, give way by being eaten through in a short time, as in the case of a ship not very long ago. He would point out to Mr. Massey that the perfect success in submarine cable jointing had been only arrived at by a constant supervision over the jointer's work by the electrician, and by every joint in the factory being duly and severely tested, and a record kept of its condition and position. In the same way workmen could only be trained to make electric light joints thoroughly, by the electrician in charge seeing to, and even testing every joint, until he could place implicit confidence in the jointer; in fact, electric light joints had to be better made, if such were possible as far as metallic contact was concerned, for the very reasons advocated by Mr. Massey. There was no difficulty in soldering a wire capable of carrying 100 amperes or more, if done in the proper way.

In respect of governors, the author would refer Mr. Paxman, Mr. Beaumont, and Mr. Oughterson to the remarks of Mr. Hedges, Mr. Crompton, and Mr. Hall. He would draw Mr. Beaumont's attention to the fact that if the main cut-out fused, or the main switch was turned off, the whole working load was instantly thrown off the engine; and that a difference of 5 per cent. in the speed meant a great difference in the electromotive force and the light. He had to a certain extent misinterpreted the action of his electric governor; what it aimed at was to keep the E.M.F. constant at the terminals of the dynamo. In answer to Mr. Mordey, the copper disk of his governor had been made over ¼ inch in thickness, to avoid as far as possible the action he feared. He was glad to learn that mechanical governors were made to keep the speed uniform within 2 per cent.

The remarks of Mr. Hall as to the ship compasses being unaffected by the strong currents passing through the electric light cables would satisfy Mr. Joel's theoretical fears. The explanation was this: the wires being underneath the iron or steel decks, the magnetic effects were shielded from the compasses placed above deck, in the same way that the delicate magnets inside Sir William Thomson's marine iron clad galvanometer were shielded from outside magnetic influences. Due precautions were taken to keep the wires sufficiently far away from the compass, if at any time they had to be brought up above deck.

Now that dynamos were made much superior to those manufactured a few years ago, the break downs on board ship were mostly due to the engines; and those whose business it was to furnish electric light engines for ship use should adopt every precaution to prevent this by making them extra strong in all the working parts, and as simple, accessible, and durable as possible, with self-lubricating connections to all the bearings from one or two common centres, capable of holding a supply of oil for three or four hours' consumption. Economy of steam was not of so much importance as durability and capability of working with a minimum of attention, combined with economy of oil. Mr. Swan would have been nearer the average consumption of coal for ship electric light engines if he had said 5 lbs. of coal per hour per indicated H.P., instead of only 2 lbs.

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* Final tests of ss. *Tainui* before leaving London for New Zealand, with all switches and cut-outs in circuit, gave I.-R. of 14·75 megohms per lamp, and a mean C.-R. of 0·28 ohm per circuit. January 26th, 1885.

† Forty-six secondary cells had been fitted on board the ss. *Olympo*, bound for the River Plate, by Messrs. Harvie, Glasgow, November, 1884. This experiment had not had a sufficiently long trial to warrant an opinion being expressed as to their suitability for ship use.

The words "nominal H.P." had been quoted by Mr. Preece in describing the lighting of the *Aurania*. What was nominal H.P.?—nominally anything; and it showed the absurdity of engine makers using this antiquated and misleading expression. Engineers should always state the indicated H.P., or better, effective-brake H.P., with such and such steam pressure and speed.

Several of the speakers misinterpreted his remarks regarding the placing of dynamos. What he said was that "the plane of rotation should be athwartship;" in other words, the dynamo-spindle should be fore and aft, which bore out the effects mentioned by them.

He had been blamed for having treated the subject of the paper in too general a way, and for not giving sufficient details of what he had done. When the members came to examine the various detail drawings with a self-explanatory index attached to each, and to consider the large amount of useful practical matter that had been elicited by the discussion and correspondence, he was fain to hope that they would credit him with having adopted the best plan under the present daily improving condition of this branch of electric lighting.

REPORTS ON ELECTRIC LIGHTING.

THERE have just been published several reports on electric lighting, made by Mr. W. H. Preece, F.R.S., to the Select Committee of the Commissioners of Sewers of the City of London. The first document is dated July 26th, 1883, and the author therein discusses the relative values and usefulness of the arc and incandescent electric light and of gas. The bulk of the matter is to the initiated unimportant, and it is therefore quite unnecessary to reproduce it in detail. After enumerating the advantages and disadvantages of the arc and incandescent systems of electric lighting, Mr. Preece thus concludes his report:—

"The proper distribution of light, so as to spread it uniformly over a given surface, is a very simple mathematical problem that can be readily solved. It is simply dependent upon the intensity of the lamp, upon the height of the posts carrying the lamp, and upon the proper distribution of the posts. It was a knowledge of the law governing this that enabled Messrs. Siemens to light King William Street so efficiently, and it is because the distribution of lamps on the Holborn Viaduct has accidentally so nearly attained this solution that the lighting of that thoroughfare is satisfactory. Were the number of lamps to be increased so that the posts could be nearer to each other, there would be no difficulty whatever in bringing the lighting of the Holborn Viaduct up to the standard of efficiency that I have enumerated at the commencement of this report. The Electric Light Committee have simply to determine what shall be the intensity of illumination upon the surface of their streets, taking the standard of illumination as that given by a candle flame of 12·7 inches. At the present moment in the neighbourhood of a gas lamp it is about one-tenth of the standard, while in the middle space between two lamps it is about one-fiftieth only. If it be determined that the illumination of our streets shall be one-tenth or one-fifth, then the proper distribution of the posts and the lamps to effect this is simply a question of calculation.

"The conclusion that I come to is, that while the arc lamp is admirably adapted for the illumination of large spaces, the glow lamp is eminently adapted for our streets and narrow thoroughfares, and I should very strongly recommend that the Electric Lighting Committee give instructions so as to determine by calculation and by experiment the best distribution of glow lamps of the proper intensity of light, that the electric light companies who propose to tender for public lighting may have before them definite figures specified to guide them in fixing their prices. These experiments would involve an expenditure of perhaps £200, and the importance of the result would certainly justify the outlay."

The second report is of a much more important character, as it deals with Mr. Preece's Wimbledon experiments. It reads as follows:—

"On the 20th September, 1883, the commissioners sanctioned a proposal that I made, to make certain experiments to determine by calculation and by experiment the best distribution of glow lamps to light up efficiently our streets and narrow thoroughfares.

"I had previously pointed out the relative advantages and disadvantages of arc and glow lamps for this purpose. The light of the glow lamp is constant, steady, and uniform. It lends itself to an even and regular illumination of streets. It requires no personal attention, no adjustment, no cleaning. It can be turned on and off in an instant. Though it enables the existing posts used for gas to be utilised, it can be fixed anywhere, and it enables us to carry out practically the theoretical solution of the difficult problem of the proper distribution of light.

"I have already indicated, in a preliminary report, the character of the experiments that I have been carrying out in the City and in Wimbledon, and I will now deal with them more fully, under the following heads:—

"1. The measurement of light; 2. The distribution of light; 3. The measurement of electricity; 4. The distribution of electricity; 5. The cost of production.

"I will also deal with the questions of domestic, central station, and street lighting.

1. THE MEASUREMENT OF LIGHT.

"To measure the intensity of a source of light is a very simple matter when we have a darkened room and a reliable photometer; but to measure the light in a street, or in a hall, when it emanates from many sources, when these sources are fixed in many positions, and at various distances, and when it falls at different angles, is a very difficult thing. The present position of photometry as practically applied to electric light illumination is by no means in a satisfactory condition. I felt that to meet the difficulty we must not depend upon any direct comparison between the light emitted by a source to be measured, such as a gas lamp, and any given recognised standard of light, such as a British standard sperm candle; but that we should rather make our standard of comparison an area illuminated to a given intensity, whatever and wherever be the source of light. We do not want to know so much the intensity of the light emitted by a particular lamp, as the intensity of illumination of the surface of the book we are reading, or of the paper on which we are writing, or of the walls upon which we hang our pictures, or of the surface of the streets and of the pavements upon which circulates the busy traffic of cities; we want to know, in fact, the degree of illumination due to the emitted light, not the intensity of the rays of the source of light. Illumination of this character depends as a rule not on one source only, but on many sources of light, distributed in innumerable ways. Hence to obtain reliable information as regards the illumination of our streets, I proposed to measure the illumination of surfaces quite independent of the sources of light by which they are illuminated.

"It was necessary in the first place to determine some standard of reference by which comparisons could be made, for all systems of measurement are simply numerical comparisons with some unit taken arbitrarily as a standard. We measure distances by reference to the *yard*, weight by reference to the *pound*, time by reference to the *second*. We know the effect on our eyesight when reading in bright daylight, or dull twilight, or moonlight, and in gas light, or the light of oil and that of candles. In a dull lighted room we are often obliged to increase the illumination of the surface of the book we are reading, by lighting an additional candle or bringing the lamp very near the book. A sperm candle burning at the rate of 120 grains per hour is the parliamentary standard of light in England. In France it is the light emitted by a Carcel lamp burning 42 grammes of pure colza oil per hour with a flame 40 mm. high. A single British standard candle placed at about a foot distance, or a French standard lamp at a metre from the page to be read, gives a very fair amount of illumination.

"As the metrical system of measurement is being gradually introduced into this country, and our relations with foreign manufactures and measures are becoming more and more intimate, it was very desirable to establish a standard that would be applicable to both systems and in all countries. I made my standard the amount of illumination given by a British standard candle fixed at 12·7 inches distance. This is very easily reproduced, and it is the same illumination as that given by the French standard light when fixed at a metre distance. It is the same illumination as that given by a steady gas flame burning 5 cubic feet per hour in London when fixed at 3·96 feet distance, or by a 20-candle incandescent or glow lamp at 4·75 feet distance, or by a 1,000-candle-power arc lamp at 105·8 feet distance. In terms of this standard the illumination at the foot of our ordinary street gas lamps, when the burner burns perfectly, is 0·1, while that at the foot of any ordinary arc lamp is 1·8. If we were to give such a standard a name such as *lux*, then the light at the base of a gas lamp post is one-tenth of a lux or a *decilux*, while that at the foot of a Brush arc is 1·8 *luces*.

"Having thus established a standard for comparison, it was necessary to devise an instrument to measure with, or to determine the arithmetical ratio between the light to be measured and this standard. Our instrument for the purpose must be light and portable, for it had to be moved about the streets. It required to be easily reproducible at any time and place, and to be absolutely uniform. I took my idea from the fairy lamps used at the Savoy Theatre in "Iolanthe." Here we had something portable, adjustable, uniform, and very easily manufactured. One of these lamps was placed inside a small box, the top of which had a screen of white paper on which was a grease spot. I was able, by increasing or diminishing the current of electricity producing the light, to vary the illumination of one side of this grease spot. When it was desired to measure the illumination of any space, such as the surface of a street, this box had simply to be put at the place to be measured, and the current had to be regulated until the grease spot disappeared. The current of electricity then became the measure of the illumination, and a simple table gave the result in terms of the new standard. The apparatus proved to be so useful, so novel, and so valuable, and it brought out so new and unexpected a law in the behaviour of the current, that I brought the matter before the Royal Society. Several forms of apparatus had to be made before I obtained one which fully met all practical requirements.

"Before giving the results of these measurements, I must now deal with the next point.

2.—THE DISTRIBUTION OF LIGHT.

"The amount of illumination received by a surface is dependent on the intensity of the source of light, and on the angle of the incident rays. The intensity of the light diminishes as the *square* of the distance increases, and also as the cosine of the angle, which the luminous rays make with the normal to the illuminated surface, diminishes. Hence the practical illumination of our streets is not a very easy question to solve when uniformity and efficiency are desired. We can have either a few intense lights, like the arc electric light, fixed at considerable distances apart, or we can have numerous small lamps distributed about at very short intervals. In the first case we must have either very imperfectly illuminated intervals, or we must have an enormous waste of light; in the second case we can have a fairly uniform distribution of light, if due regard be paid to the laws regulating this distribution. The more intense the light, and the greater the distance apart, the greater the loss and the waste. It was desirable, in the first instance, to find out how light was practically distributed in our streets, and then to determine how best it could be done by glow lamps.

(*To be continued.*)

NOTES.

The Electric Light and Russian War Preparations.—According to advices from Odessa and Sebastopol there is great activity in the arsenals and dockyards of these two Black Sea ports, the electric light for the purposes of work turning night into day.

The Electric Lighting Act.—Last Monday in the House of Commons, Mr. Stanhope asked the President of the Board of Trade whether he proposed to introduce a Bill this year to amend the Electric Lighting Act. Mr. Chamberlain: No, it is not my intention.

The Electric Light at Portsmouth. — Some time ago Messrs. G. S. Lancaster & Co. and Messrs. Antill, of the Hard, Portsmouth, adopted the electric light for the illumination of their premises and have used it ever since, the result having surpassed the most sanguine expectations. The flickering, the principal objection, has been reduced to a minimum and the powerful lamps light up the whole of the street in the most perfect manner. No doubt, the electric light will ere long be adopted by other tradesmen in the town. Most of the ships stationed at Portsmouth are now fitted with apparatus for producing the beautiful illumination, the efficacy of which is strikingly apparent when one of the vessels in harbour, on a dark night, throws its light on the town.

Advertising by the Electric Light.—We hear that Messrs. Barrett & Co., Limited, Vauxhall, are about to place upon their new brewery an immense weather vane in the shape of a bottle, 20 feet long and 6 feet in diameter. Indications will be afforded as to the direction of the wind by night as well as day, for it is proposed to light each end of the bottle with a powerful arc light of 2,000 candles—the one showing red, the other white rays.

Temporary Installation.—During the holding of a bazaar in the Public Hall, Downham, Norfolk, at the end of March, the building was brilliantly illuminated by about 50 incandescent lamps, the current being supplied by an Oppermann dynamo driven by a small steam engine lent to the promoters of the bazaar by Mr. Redit, a local engineer. It was the first time the electric light had been seen at Downham, and Messrs. Oppermann Brothers, were responsible for the work.

The Electric Light at the Dinner Table.—At the Highland and Agricultural Society's Spring Flower Show, held in Edinburgh last week, there was a unique display of electric lighting of a dinner table *a la Russe* by Messrs. Jenkinson, of Princes Street. The candelabra and centre piece being of china, from which the lamps hung, decorated with flowers, presented a very artistic appearance. Round the table at intervals were growing plants with a glow lamp in the centre of each, which produced quite a novel effect. All wire on the table was completely hidden by green foliage. The current was supplied from accumulators underneath the table. The ornaments were specially manufactured for use with the electric light, and the lighting arrangements were carried out by Mr. James Gibson.

The Royal Visit to Ireland.—On Wednesday the Prince and Princess of Wales landed near Queenstown, and in the evening the ships of the Channel Squadron, and the guardship at Queenstown, were illuminated with the electric light and a variety of coloured lights.

The Society of Telegraph Engineers, &c.—At the meeting next Thursday, we believe, there will be a discussion on Prof. Oliver Lodge's paper on "The Seat of Electromotive Force in a Voltaic Cell," and a deferred paper on "Electrical Definitions, Nomenclature and Notation," by Andrew Jamieson, F.R.S.E., member.

Electric Lighting in the Navy.—The Admiralty has entered into a contract with the Anglo American Brush Electric Light Corporation for a further supply of Victoria dynamos, coupled to Brotherhood engines, which are to be furnished as speedily as possible to the following gunboats now being rapidly pushed forward at the various dockyards, namely, H.M.S. *Inconstant*, at Devonport; H.M.S. *Rupert*, *Nelson* and *Invincible*, at Portsmouth; and H.M.S. *Orion*, at Deptford.

Proposed Electric Light on North Carr Rock.—At the monthly meeting of the Dundee Harbour Board last week, it was reported that Mr. Thomas Stevenson, engineer to the Northern Lighthouse Commissioners, had suggested the feasibility of maintaining a light by means of electricity on the North Carr Rock, and that Principal Jamieson, of the College of Science and Arts, Glasgow, was to be consulted on the subject.

Electric Lighting at the Grosvenor Gallery.—Whatever may be the respective merits of electricity and gas, there can be no question that as regards picture galleries, at least, electricity must be the light of the future. A very interesting experiment was recently made at the Grosvenor Gallery, with the view of testing, by contrast, the two systems of lighting. In the East Gallery the 400 gas burners there were lighted to their full power; in the West Gallery ten electric "Sun" lamps took the place of 800 gas jets. The result showed that, whilst in the one gallery the gas seemed to throw out a lurid, yellow light that imparted false shade and colour to the surrounding pictures, the white, steady glow from the "Sun" lamps brought out the pictures in the other gallery in clear and correct definition, exactly as in ordinary daylight. The experiment, which was continued for two consecutive nights, was witnessed by a distinguished company, including Sir Frederick Leighton, Mr. Alma Tadema, and Sir Coutts Lindsay, and was pronounced by all to be a complete success as regards the superiority of the electric light. Mere effect, however, is not the only desirable feature possessed by electricity. The heat, smoke, and other vapour from gas has a very deteriorating effect upon pictures—and, indeed, upon most works of art. No such results attend the electric light, which throws off little heat and neither smoke nor vapour, advantages the importance of which cannot be overrated now that we have pictures in our collections costing £70,000 and £50,000. The Grosvenor Gallery will in future be lighted by these "Sun" lamps, which are the same as those in use for some time in the picture gallery and Jones collection at South Kensington Museum. They seem to combine the desiderata so much looked for in electric lighting, viz.: a white, yet mellow light, free from violet or blue shade, with perfect steadiness of light.

Electric Lighting of the British Museum and Natural History Museum.—During the discussion in the House of Commons on Thursday last week upon the Civil Service estimates, Mr. Molloy pointed out that the Trustees of the British Museum had recommended the introduction of the electric light, but that the Government had refused to give the £14,000 necessary for the erection of the apparatus. Would the Government give the money now, or would they still continue to refuse it? Sir G. Campbell pleaded for the introduction of the electric light to the South Kensington Natural History Museum. It was visited by nursemaids and others in the daytime, but for want of lighting in the evening the working classes were deprived of the opportunity of seeing the collections. Mr. H. Gladstone said that as it appeared to be the general sense of the committee that the electric light should be introduced in the evening, he would bring the matter under the notice of the First Commissioner of Works. Mr. Molloy said the subject had been brought under the notice of the First Commissioner for two years past by himself and other members of the House. As it was evident the working classes could not visit these places in the daytime, the want of lighting in the evening had the effect of benefiting the upper classes at their expense. In order to mark his sense of the refusal of the Government to extend a benefit of this kind in the direction of the working classes, he moved the reduction of the vote by £1,000. Mr. Shaw-Lefevre said that all he had promised to do in the matter was to refer it to the Trustees of the British Museum. The question was one which rested with the Trustees of the British Museum and the Treasury; and the First Commissioner of Works had nothing to do with it. All that the First Commissioner had to do with the British Museum was to undertake the construction of any works and to maintain the building; and it did not rest with him to decide whether it should be lighted up in the evening with the electric or any other light. That was not merely a question of the expenditure of £14,000 for the introduction of the electric light; but it also involved the cost of a considerable increase of the staff. He did not himself express any opinion as to whether that large expenditure ought to be incurred or not; but he had great doubts whether the Trustees desired such a measure to be adopted. Mr. Molloy said that last year one of the Trustees, who sat in the House, mentioned that they had made an application to the Government for the necessary funds for introducing the electric light into the British Museum, in order that the institution might be open to the working classes in the evening, and that the application had been refused. Sir G. Campbell expressed his surprise that the Postmaster-General, after referring the matter to the Trustees last year, was now unable to state what their opinion on the subject was. Mr. E. Stanhope observed that what the Committee was given to understand was that the Trustees had a year and more ago represented to the Treasury that the time had come when, in their opinion, the Museum should be fitted up with the electric light. He would like to know, therefore, what answer the Treasury had given to that application. It was said that the Treasury had refused: but upon what grounds was the refusal based? The representations made to the Treasury by a body like the Trustees of the British Museum were entitled to the fullest consideration. The Chancellor of the Exchequer pointed out that there were two sides to all these questions of electric lighting, but the improvement effected in certain buildings by its adoption was so great that he could not refuse to take the matter into consideration. He therefore promised the House to give his attention to the question.

Electric Lighting at Herne Bay.—As the result of the efforts of a committee formed at a late public meeting on the question of electric lighting at Herne Bay, there is now every probability of a small installation being fixed at Messrs. Barnwell's premises in Mortimer Street. Mr. Hamilton, who has been moving most in the matter, has undertaken to give a public exhibition of the electric light upon the formation of a small guarantee fund.

The Lighting of the ss. "Angelo."—This fine and favourite steamer of the Wilson Line, which is regularly engaged in the mail and passenger service between Hull and Christiania, is now fitted with the electric light. In every part of the vessel, including the masthead and side lights, this modern means of lighting has been introduccd, and altogether there are 120 lights. The fittings have been placed on board by Mr. T. Muse, who has been engaged by Messrs. Thomas Wilson, Sons & Co. as their electrical engineer. The current is generated by one of Paterson and Cooper's Phœnix dynamo machines, and the lamps are the Edison-Swan. The masthead and side lights are, however, fitted with the Bernstein incandescent lamps, and the engine to drive the dynamo has been supplied by Messrs. Rose, Downs and Thompson. The masthead and side lights have been designed by Mr. Muse, and manufactured by Messrs. Whitfield and Hakes, Commercial Road, Hull. All the fittings have been made locally, by Messrs. G. Clark and Son, or by Messrs. Whitfield and Hakes.

The Portsmouth Telephone Exchange.—At a meeting of the Chamber of Commerce last week a letter was read from Mr. Henry Lewis, general manager and secretary of the Western Counties and South Wales Telephone Company, explaining that the agreement verbally entered into by himself on behalf of the company with the Chamber, having reference to the telephone exchange which has just been opened, had been duly signed. At the request of the Chamber he would with pleasure extend the date for signing the agreement forms from 31st March to 30th April. For orders signed prior to the latter date rental would commence and be payable on the first of the third months following actual date of connection. The hon. secretary (Mr. W. Edmonds) said if the exchange was to be of any practical utility, as many members as possible must join at once. Alderman Pink, who presided, said there were already a number of private wires in the town, but these were merely from office to office, and they would be united by means of the exchange. In reply to Councillor Wenter, the chairman stated that it was not intended to connect Portsmouth with London. It is anticipated that in the course of a few weeks the exchange will be in full working order.

Telephonic Charges.—At the closing meeting of the Royal Convention of Burghs in Edinburgh last week, on the motion of the Senior Assessor for Edinburgh, it was resolved to memorialise the Postmaster-General to reduce "the present excessive rate charged for telephonic communication by the Post Office exchanges or for private wires supplied by them." Resolutions were also remitted to the Annual Committee on the question of foreign telegrams.

Sixpenny Telegrams.—Mr. Shaw-Lefevre's Bill providing for sixpenny telegrams has just been printed. Its principal provisions are the following :—Section 15 of the Telegraph Act, 1868, shall be repealed, and in place thereof be it enacted as follows : The Postmaster-General, with the consent of the Commissioners of Her Majesty's Treasury, may from time to time make regulations for determining the hours during which the offices appointed by him to be places for the receipt and despatch of telegrams shall be open for the transaction of telegraphic business, and for fixing the sums to be from time to time paid on account of the transmission of telegrams, and on account of services rendered in connection therewith, and on account of the use of any telegraphs by any persons, and for determining the conditions and purposes on which and for which such use may be permitted, and for the general conduct of telegraphic business ; provided that (1) the charges for the transmission of written telegrams throughout the United Kingdom shall uniformly and without regard to distance be at a rate not exceeding sixpence for the first 12 words of each telegram or for each telegram of less than 12 words (counting as part of such 12 words the names and addresses of the sender and addressee of the telegram), and not exceeding one penny for each additional two words or part of two words ; (2) the sums charged for the transmission of written telegrams shall be held to cover the costs of delivery by special foot messenger, within the limit of one mile of the terminal telegraphic office, or within the limit of the town postal delivery of that office, when it is a head post-office and the town postal delivery extends for more than a mile from it ; (3) when the addressee does not reside within the above-described limits, and the sender desires to have his telegram delivered by special foot messenger, the charge to him for porterage by such special messenger shall not exceed sixpence per double mile, or any part thereof, beyond such limits ; (4) when the addressee does not reside within the above-described limits, and the sender does not desire to incur the cost of special delivery, his telegram shall be delivered free of extra charge by the ordinary postal delivery next following on the arrival of his telegram at the terminal telegraphic office. The repeal of section 15 of the Telegraph Act, 1868, shall not affect the validity of any regulations made under the said section before the passing of this Act, and such regulations and all charges made thereunder shall remain in force until revoked by the Postmaster-General with the consent of the Commissioners of Her Majesty's Treasury, or superseded by regulations made under this Act.

Mr. Stuart-Wortley has given notice that on the second reading of the Telegraph Acts Amendment Bill he will move, "That a State department enjoying a monopoly for inland telegraphic communication and liable practically to no penalty for the non-delivery of messages, is not, in the opinion of this House, justified in proposing so to adjust its tariff as to discourage the full statement of all particulars reasonably necessary for the identification of the persons to whom and the place at which it contracts to deliver the messages which it receives for transmission."

The *Daily News* believes there is every probability that Lord John Manner's amendment on the Telegraphs Bill in favour of free addresses will be carried. In that event, the Postmaster-General will abandon the Bill, and the introduction of cheap telegrams will be postponed for a year. As the sixpenny telegrams would have involved a considerable sacrifice of revenue, the Chancellor of the Exchequer will not, under present circumstances, regret the postponement of their introduction for twelve months.

The Telegraph in Central Asia.—In the event of war occurring between this country and Russia the telegraphic facilities which either combatant will enjoy will be an important consideration. As far as regards that portion of Central Asia to which attention is now particularly directed, Mr. Charles Marvin quotes from the Russian semi-official *Kavkaz*, showing that direct telegraphic communication exists between St. Petersburgh and Merv, from which place General Komaroff could be communicated with in less than a day. Six or seven days are necessary to effect communication with Sir Peter Lumsden from London.

New Telegraph Station in China.—The Great Northern Telegraph Company announces that a telegraph station has been opened at Newchwang. Telegrams for that place are now accepted for transmission by this Company's lines at the rate of 10s. per word.

Code Telegrams to China.—The Imperial Chinese Telegraph Administration notifies that private telegrams written in code are again accepted on the Chinese land lines (Pekin, Tientsin, Hankow, Swatow, Canton, &c.).

The "International."—The ss. *International* arrived at Suakin on the 9th inst., having been somewhat delayed by the block in the Suez Canal.

Loss of the "Magneta."—There is now little doubt that the steamer *Magneta*, belonging to the Eastern Telegraph Company, which left London on March 8th for Malta with a large staff of telegraph officials on board, has gone down in the Bay of Biscay. The Cunard steamer *Palmyra* reported on her arrival at Genoa that when in the Bay of Biscay, 200 miles north of Finisterre, on March 24th, she passed a lifeboat belonging to the *Magneta*. The boat, which was in fairly good condition, contained mast and oars, but no sail.

A further telegram relative to the boat picked up, states :—"No evidence of boat having been occupied ; oars did not appear to have been used ; part of mast lying across gunwhale and about 18 inches of top plank knocked in ; otherwise in good condition, and appeared to have been properly lowered.

Telegraph Materials.—The Manchester, Sheffield, and Lincolnshire Railway Company is advertising for tenders for the supply, among other things, of telegraph materials.

Submarine Cables and War Prospects.—Replying in the House of Lords on Tuesday evening to Viscount Sidmouth, the Earl of Derby said the noble viscount was probably aware that there were two alternative lines of telegraphic communication between this country and Hongkong. One of these lines passed through Russian territory in Siberia and down the Chinese coast to Hongkong, and the other, from England to Singapore, which was more generally used, passed through Saigon, the French settlement, to Hongkong. It was true that both these lines passed through foreign territory, but they did not both pass through territory belonging to the same power; and if by any unfortunate event communication by one line was cut off there would still remain the other. There was at the present time under the consideration of the authorities a proposal to make a line direct from Singapore to Hongkong. That proposal was being considered by the various departments concerned, but he was authorised by his noble friend the First Lord of the Admiralty to say that the Naval authorities, while not denying that such a line would be useful, did not regard it as of primary urgency, and they considered that the expenditure which would be involved might be more usefully employed elsewhere. At the same time that was the opinion of only one of the departments concerned, and no final decision had been come to by the Government as a whole. The consideration of the matter so far, however, pointed to the fact that this would be a most expensive line, as the cost of maintaining it would not be less than £20,000 a year; and in the next place, even if we had the line, it would not serve the purpose of carrying the whole communication in such a way as to avoid the territory of any foreign Power, because it would be necessary for that purpose to do that which had been often proposed, viz., to make an independent line of telegraph to Gibralter and Malta. The Earl of Carnarvon said that this question of submarine telegraphs ought not to be considered simply and solely on the ground as to whether the line would pay commercially. It must be remembered that these stations were valuable to this country, not only as great commercial emporia, but they were great military and naval outposts. He wished to call attention to an important point in connection with this matter, and that was the extreme importance at this particular moment of the Government taking every precaution in their power against these submarine telegraphs being exposed to greater risks than necessary. It should be remembered that most of our commercial transactions at the present time were begun in the first instance by telegraph, and also that nearly all these lines were worked and managed by English capital. Commercially and politically, therefore, they were English property, and deserved every consideration at the hands of the Government. He wished also to point out that in time of war these submarine lines were exposed to very great and peculiar risks, while, on the other hand, through the development of modern science, they could be easily repaired. The stores necessary to repair them should be close at hand and available. He sincerely trusted that during a time of peace when the Government had full opportunity of making preparations they had taken the necessary steps to secure an available supply of stores. There was not a large stock of telegraphic cable in this country, but it could be manufactured very rapidly when a certain stage of the proceedings had been arrived at. The matter was a delicate one, but he thought it right to remind the House and the country that in 1878, when there were great alarms as to a Russian war, the Russian Government, who were perhaps more alive to the circumstances of the case than we were, had taken measures for cutting the submarine cables, and for equipping ships for that special purpose. It was said at the time, and on good authority, and was generally believed, that there was a carefully elaborated scheme for taking measures against our submarine cables in the Eastern waters. The Earl of Northbrook said there was a line, no doubt, almost entirely in English hands, to Malta, and so on to Hongkong. He could assure the noble earl opposite that he was quite mistaken in supposing that the Government looked on these lines only from a commercial point of view, and, if he thought so, he must have misunderstood what had been said. He could assure the noble earl that the Government had by no means shirked their responsibility in the matter. The Marquis of Salisbury said there was a point as to whether the duty of a neutral was fulfilled if he conveyed a warlike message by telegraph. If there was any doubt upon that point the importance of submarine lines would become very great. He was not aware whether it had been decided; but he could easily imagine that if the neutrality of any Power towards us was not very benevolent difficulties might arise.

Cable Connections in the Red Sea.—The Italian Government is negotiating with the Eastern Telegraph Company to lay a cable from Massowah to Assab and on to Perim, where the company has a station.

The Isle of Man Cable.—The steamer *Monarch*, with the new submarine cable for the Isle of Man arrived at Ramsey on Monday, and telegraphic communication with the island will be interrupted for a few days. Telegrams, however, will be despatched per mail steamers *viâ* Liverpool. The new cable, which will be laid from Cornay, south of Ramsey Bay, direct to St. Bee's Head, so as to avoid bights in the coast, includes one direct wire to Liverpool, one to Manchester for the Lancashire and Yorkshire districts, and a spare one to provide for the prompt despatch of business during the visiting season. It is intended to remove the old one-wire cable.

A New Torpedo Guide.—Hitherto (writes our Portsmouth correspondent) there has always existed considerable uncertainty as to the action of torpedoes, which have occasionally inflicted injury upon those by whom they have been launched. From time to time thousands of pounds sterling have been expended in experiments; but the great difficulty which has always been experienced in guiding the deadly explosives has not hitherto been satisfactorily solved. A machine which has just been patented gives fair promise of fulfilling all that can be desired in this direction, and of making the torpedo a still more powerful weapon of destruction. In order to attain this end the aid of electricity is evoked. On the torpedo being launched a thin insulated wire is paid off, which immediately sinks, and thus prevents the enemy from destroying communication. The operator controls the movement of the torpedo by transmitting a negative or positive current of electricity, and the "torpedo guide," as the new invention is termed, is so constructed that the attack can be directed to any given point with mathematical precision; whilst, it is claimed, it can control the action of the torpedo at a distance of three miles. Moreover, it is stated that even if the vessel from which the torpedo proceeded, and the craft attacked were steering different courses, it could still be employed with deadly certainty. The attention of the Admiralty has been directed to this invention, which, should it only fulfil what is expected of it, will completely remove the difficulties at present existing in regard to torpedo warfare, and will have solved a problem which has long puzzled naval experts.

Electric Locomotion at the Alexandra Palace.—In connection with the exhibition at the Alexandra Palace, opened on the 31st ult., it is stated that there will shortly be completed for passenger conveyance a line of railway, about a mile in length, leading from the gate of the Palace grounds to the Palace itself, by which visitors will avoid a tedious up-hill walk. The line will be worked by electricity.

Overhead Wires and Local Authorities.—At the meeting last week of the Lambeth Vestry, the Parliamentary Committee reported that they had considered the letter from the clerk of the committees of the House of Commons on the subject of telephones and telegraph wires. In their (the committee's) opinion, the control and management of the telephone, telegraph, and overhead wires in general should be placed under the several vestries and district boards through which such wires passed, and not under the control of the Metropolitan Board of Works. The committee, however, felt that it was very necessary, if possible, that all the vestries of London should agree on some uniform system. They had, therefore, directed the clerk to invite the several vestries and district boards to a conference to be held at the Lambeth Vestry Hall. This report was adopted.

The clerk to the St. Saviour's Board of Works last week stated that the Select Committee proposed to hear three witnesses only from the vestries of the metropolis.

NEW COMPANIES REGISTERED.

Volta Electrical Company, Limited.—Capital £5,000 divided into 4,000 preference and 1,000 deferred shares of £1 each. Objects: To take over the business and property of Mr. F. D'A. Goold, of Manchester, including all patents relating to electrical apparatus. Signatories (with one share each): C. M. Nesbitt, 42, Market Street; H. Lindley, Brooklands; F. Browett, Eccles; F. D'A. Goold (electrical engineer), 29, Arcade Chambers; C. G. Taylor, (electrical engineer), 29, Arcade Chambers; H. Simmons and E. Guthrie, 32, Brown Street, all of Manchester. Directing qualification: Preference shares or stock of the nominal value of £50. The first directors are Messrs. F. Wynne, W. T. Glover and T. Browett. Registered 13th inst. by Messrs. Renshaws, 2, Suffolk Lane, Cannon Street, E.C.

Thompson's Electrical Fitting and Screw-Cutting Company, Limited.—Capital: £3,000 in £1 shares. Objects: To acquire the business of Messrs. Thompson and Rew, of 77, Turnmill Street, E.C., and to manufacture electrical fittings, screws, and brass work. Signatories: *G. A. Hutton Croft, Borough Bridge, Yorkshire, 500 shares: Miss E. F. Thompson and Mrs. G. E. Thompson, 7, St. James's Terrace, Regent's Park; W. E. Crompton, 23, Porchester Gardens; *N. G. Thompson, H. J. Dowsing, and *G. H. Rew, 4, Queen Victoria Street, one share each. Directing qualification; 50 shares. Remunerations: £1 1s. every attendance at board meetings, and one-fourth of the nett profits remaining after payment of 10 per cent. dividend. Messrs. G. H. Rew and N. G. Thompson are appointed managing director and secretary, respectively, each at a salary of £78 per annum. Registered 15th inst. by Hughes, Masterman and Reid, 59, New Broad Street, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Edison-Gower-Bell Telephone Company of Europe, Limited.—The annual return of this company, made up to the 8th inst., was filed on the 9th inst. The nominal capital is £500,000 in £1 shares. 365,007 shares have been taken up, 350,000 having been issued as fully paid up. Upon the remainder £15,003 has been paid up, and £4 remains unpaid.

Anglo-Spanish (Brush) Electric Light and Power Company, Limited.—The annual return of this company, made up to the 31st ult., was filed on the 11th inst. The nominal capital is £200,000 in £5 shares. 8,907 shares have been issued, and £3 per share has been called up, the calls paid amounting to £26,038 10s., and unpaid to £682 10s.

At an extraordinary general meeting of the company, held at the offices, 110, Cannon Street, on the 17th ult., it was resolved to wind up voluntarily, and Messrs. John Norris Grove and Arthur John Davis were appointed liquidators, the former at a remuneration of £100, and the latter at a remuneration of £20. These resolutions were confirmed on the 9th inst. and duly registered on the 10th inst.

CITY NOTES, REPORTS, MEETINGS, &c.

The Indo-European Telegraph Company, Limited.

The directors report for 1884 states that the company's revenue from all sources for the year amounted to £98,103 11s. 9d.

The expenses were—on commercial and general account, £24,639 5s.; on maintenance account, £28,684 14s. 6d., including £151 14s. 7d. paid to the Russian Government; total, £53,323 19s. 6d.

Deducting the above expenses, taking credit for £6 15s. 4d. balance brought over from 1883. and debiting income-tax, there remains the sum of £43,571 16s. 3d.

From this amount, £10,625 paid for interim dividend, and £5,000 paid to Messrs. Siemens in final liquidation of their agreement of the 16th July, 1868, have to be deducted, leaving a balance of £27,953 11s. 7d. available.

The directors propose the declaration of a dividend for the last six months of 17s. 6d. per share, making, with the interim dividend already paid, 6 per cent. for the year, and a bonus of 10s. per share, both free of income-tax, making in all 8 per cent. for the year. The balance of £4,578 11s. 7d. will be carried to the credit of 1885.

The amount received on account of the Persian debt, £1,986 1s. 4d., constitutes the first payment on account of the item of £21,846 15s. 4d. standing to suspense account, which will be gradually liquidated by similar annual deductions from the royalties payable by the company to Persia.

The maintenance expenditure includes half the cost of a new cable with four conducting wires successfully laid across the Straits of Kertch and delivered up by Messrs. Siemens in perfect working order; the other moiety of the cost is borne by the Russian Government, and the future maintenance of the cable will be at the joint expense of the Government and the company, each administration having the use of two wires.

The agreement between the postal department and the company for the exclusive use of one wire from London to Emden, on the German coast, came to an end on the 24th December last.

A new agreement has been entered into under which the company has leased two wires from London to Emden; the one wire being in the Reuter cable, and the other in the German Union cable, so that by these means a duplicate route is secured.

Owing to re-arrangements made under the same agreement in respect of Russian and Turkish traffic it is anticipated that the nett cost to the company will undergo no material alteration.

The German Government has placed at the disposal of the company a second wire between Emden and Berlin, and by means of the duplication of the Kertch cable and certain alterations made, and still being made, on the company's system, a through route of two effective wires has been in operation since the beginning of March.

The result upon the working of the company's line between London and Teheran has been eminently satisfactory.

Great Northern Telegraph Company.—The company's working account for the past year shows that the balance on the 31st of December, 1883, amounted to £25,644, the traffic receipts of the year 1884 to £276,199, interest to £11,478, and sundry receipts to £11,340, together £324,662. The total expenses were £78,657, the interest on and amortisation of debentures absorbed £34,000, the interim dividend of 5s. and an extra dividend of 3s. per share took £120,833, and after placing £55,555 to the reserve and renewal fund, and £2,778 to the pension fund of the staff, and deducting £1,500, directors' remuneration, a balance of £31,338 remained to be carried forward.

British Electric Light Company, Limited.—A petition for winding up this company has been presented by Otway Edward Woodhouse and Frederick Laurence Rawson, of 11, Queen Victoria Street, E.C., electrical engineers, creditors of the company, and the petition is directed to be heard before Vice-Chancellor Bacon to-day (Saturday).

Consolidated Telephone Construction and Maintenance Company, Limited.—The Court has confirmed the special resolution reducing the capital of this company from £300,000 in £1 shares to £243,787 10s. divided into 224,850 shares of 15s. each and 75,150 shares of £1 each.

TRAFFIC RECEIPTS.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending April 10th were £2,471, after deducting the fifth of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited.

NEW PATENTS—1885.

4061. "Transmitter of Farquharson and Lane's electric ships' telegraph." W. SKINNER, J. FARQUHARSON, D. W. LANE. Dated March 31.

4063. "System of electric railway signals." W. T. WATERS. Dated March 31. (*Complete.*)

4110. "Electric arc lamps." H. W. PENDRED. Dated April 1.

4120. "Dynamo electric machines." G. FORBES. Dated April 1. (*Complete.*)

4130. "Apparatus for intensifying electrical currents." F. P. E. DE LALANDE. Dated April 1. (*Complete.*)

4137. "Methods for transforming, distributing, controlling, and utilising electric and magnetic force, and apparatus or means employed therefor or in combination therewith." J. S. WILLIAMS. Dated April 1.

4141. "Appliances for and mode of connecting, clamping, and holding the cables, wires and conductors used in the transmission of electric currents." O. MARCH. Dated April 1.

4155. "Boxes or cells for primary and secondary voltaic batteries." C. MOSELEY. Dated April 2.

4210. "Apparatus for inducing electric sparks for gas lighting and like purposes." A. R. MOLISON. Dated April 2.

4254. "Acoustic or mechanical telephones." H. SELIGMAN, EMMA SELIGMAN. Dated April 7. (*Complete.*)

4265. "Constructing cables for conveying messages, and for motive power and lighting purposes." J. C. SELLARS. Dated April 7.

4273. "Method and apparatus for telegraphy." J. C. LUDWIG. Dated April 7. (*Complete.*)

4286. "Moderators for electric lamps." E. L. ROUSSY. Dated April 7.

4287. "Autographic or copying telegraph instruments and circuits." A. M. CLARK. (Communicated by S. P. Denison.) Dated April 7. (*Complete.*)

4308. "Galvanic gas batteries." G. F. REDFERN. (Communicated by A. Bernstein.) Dated April 7.

4357. "Construction and operation of electrical machines or apparatus and circuits thereof and means employed therewith or therefor." J. S. WILLIAMS. Dated April 8.

4358. "Methods or means of operating and controlling electrical machines or apparatus and the circuits thereof and apparatus or means therefor." J. S. WILLIAMS. Dated April 8.

4359. "Methods of or means for transforming mechanical force into electric or *vice versa*, and apparatus employed therewith or therefor." J. S. WILLIAMS. Dated April 8.

4360. "Method or means for constructing, operating, and controlling electrical machines and apparatus or means therefor." J. S. WILLIAMS. Dated April 8.

4363. "Fixing the carbon filaments of incandescence lamps." A. M. CLARK. (Communicated by the Electrotechnische Fabrik Cannstadt.) Dated April 8.

4369. "Electric batteries." P. JENSEN. (Communicated by W. Hellesen.) Dated April 8. (*Complete.*)

4371. "Electro-plating of vegetable, animal and other substances." W. R. LAKE. (Communicated by C. E. Quintallet and A. I. Mahu.) Dated April 8.

4423. "Electro-telephonic instruments." S. P. THOMPSON. Dated April 9.

4444. "Ventilator and combined gas burner lit by induction coil." P. D. MENZIES. Dated April 10. (*Complete.*)

4498. "Coating metals with an electro deposit of platinum." W. A. THOMS, H. F. ODDY. Dated April 11.

4506. "Telegraphs." C. LANGDON-DAVIES. Dated April 11.

4534. "Automatic safety devices for use with electric currents." R. P. SELLON. Dated April 13. (*Complete.*)

4541. "Electric telephony." J. G. LORRAIN. Dated April 13.

4542. "Primary electric batteries." H. MOWER. Dated April 13.

4584. "Galvanising baths." T. MINNIS. Dated April 14.

4585. "Regulator of the carbon points in the arc light." S. EIDLITZ. Dated April 14. (*Complete.*)

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1884.

4786. "Improvements in fire arms designed for discharge by electricity." T. P. WOOD. Dated March 12. 6d. This invention consists in so arranging the wires of the fire arm that the current is conveyed by them to the rear of the cartridge. The wire from one of the poles of the battery, which may be conveniently carried in the butt, passes direct to the rear of the cartridge, but is divided as required to permit the opening of the breech and to enable the arm to be taken to pieces. The other wire from the opposite pole, in addition to being divided similarly to the first, has a gap or break therein above the trigger. In the base of the cartridge case are two wires extending into the powder chamber, and across the inner ends of these wires is placed a link of platinum or other good conducting material. Against the outer ends of the wires in the cartridge case bear the ends of the wires in the action, one of which, as aforesaid, is electrically connected directly to one pole of the battery. The act of pulling the trigger electrically connects the other wire with the battery through a contact piece carried on the top of the trigger, which contact piece is raised into and bridges over the gap or break aforesaid.

5020. "Improvements in Telpherage." F. JENKIN. Dated March 17. 6d. The main object of the present invention is to supply the means of transmitting parcels at high speeds by telpherage, but part of the improvements are applicable to slow speed telpherage. The inventor adheres to the single wheel path for each vehicle, as in the systems already described by me, but for high speed the road should always be made rigid. Also he employs the trucks already described in a provisional specification filed by him, but for high speed telpherage he arranges two parallel wheel paths preferably made of bulb iron with the bulb of circular cross section and an undercut web placed in one vertical plane where the line is straight. On each of these wheel paths separate trucks or trains run, free to rock or roll sideways on the roads as in the systems previously described by me. He connects the upper and lower trucks or trains by a connection sufficiently strong to allow the one truck or train to haul the other, but sufficiently flexible or elastic, or both flexible and elastic, to leave each train or truck almost complete freedom to rock or roll on its line. One of the trains or trucks, or in certain cases both trains and trucks, are driven by a telpher locomotive, similar to those already employed by him, except that the reduction of speed of the motor by gearing is either nil or much smaller than in the low speed telpherage, and he passes the current driving the motor or motors from the one road to the other through the motors by means of the flexible connection between them. One of the two roads is insulated, the other is not or need not be.

6023. "Improvements in terminals or binding posts of electrical apparatus." A. M. CLARK. (Communicated from abroad by L. de Combettes, of Paris.) Dated April 5. 6d. Consists broadly in the substitution of spring pressure for the binding screws generally used for attaching the conducting wires, or for making connection in an electric circuit. The advantages of this invention are: 1st, a more perfect contact owing to the larger surface clamped. 2nd, rapidity of attachment, it being simply necessary to insert the contact tongue in the stud without any screw adjustment. 3rd, permanent contact not attainable with screw studs, which are liable to work loose, especially in apparatus which is portable or subject to vibration. Figs. 1, 2, 3, respectively represent an elevation, top view and vertical section of one arrangement in which the spring is external. *a* is the contact tongue (shown separately in fig. 4). It is slotted or forked at *b* to embrace the binding stud, *d*, and is inserted between the head of the loose sleeve, *c*, on stud, *d*, and the cross pin, *e*, passing through the top of said stud. The stud, *d*, is fixed by its flange, *f*, and a nut, *g*, on its lower threaded end to the base plate. In fig. 4 the spring is coiled about the stud, *d*, as before, and enclosed in a socket, *i*, the stud, *d*, passing through a hole in and bearing by a shoulder on the bottom of said socket and secured by a nut, *g*.

FIG. 1.

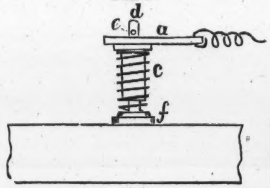


FIG. 3.

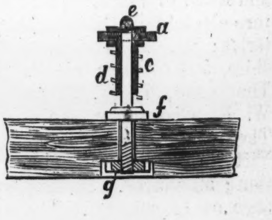


FIG. 2.

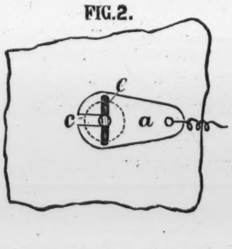
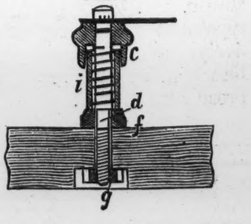


FIG. 4.



6091. "Improvements in electric telephone transmitters." J. H. JOHNSON. (Communicated from abroad by J. A. Maloney, of America.) Dated April 8. 6d. Refers more particularly to a telephone transmitter of the type described in the specification of Letters Patent No. 1452, of March 20th, 1883, but in some respects it is susceptible of application to transmitters of other types. The said invention is directed mainly to an improved construction and arrangement of the contact points through which the impulses due to the vibrations of the diaphragm are transmitted to line and in this respect is characterised principally by the combination with the diaphragm of a contact point a spring acting carrier therefor attached to and moving with the diaphragm and a controlling device termed by the inventor "stirrup," which bears upon the spring carrier, and, during the vibratory movements of the latter, operates to direct its movements to and from the stationary contact point in connection with which the carriers contact point works. It also has to do with the carbon contacts of electric telephone transmitters and other instruments in which microphonic contact is required, the object being to keep the microphonic contact unimpaired, and to prevent the accumulation and building up between the contacts of fine carbon dust, which results finally in establishing a closed circuit between the contacts thus incapacitating the instrument for efficient work. This object can be attained by interposing between the carbon contacts loose iron filings or other metal in a state of minute division, the easiest way of practically carrying out this improvement being to place the carbon contacts vertically one above the other, and to sprinkle the acting face of the under carbon contact with iron filings, which are kept in place by a rim around the edge of the carbon.

6092. "Improvements in receiving telephones." J. H. Johnson. (Communicated from abroad by J. A. Maloney, of America). Dated April 8. 6d. Relates to the kind of receiving telephone in which are combined a magnet, a non-magnetic diaphragm, and a reed-like armature fastened to the diaphragm, and the object of this invention is to obtain a simple and efficient instrument of this kind, it being characterised by the combination with the magnet and the non-magnetic diaphragm of a special form of armature, which for convenience sake is termed a "multiple reed armature, the said armature being opposite the pole or poles" of the magnet and consisting of two or more reeds or strips which have their free ends opposed to and separated by a short interval from one another, and are formed in one with a supporting plate which is fastened tightly to the diaphragm.

6228. "Improvements in secondary batteries or electrical accumulators." J. S. Sellon. Dated April 10. 6d. Has for one of its objects the prevention of the leakage which may occur in some forms of plates of secondary batteries, as, for instance, in the forms wherein what are known as cone or pyramid shaped plates are used, especially if such plates be made of cast lead and be used as compound plates or double electrodes, *i.e.*, negative on one side and positive on the other, they being available also as vessels for containing the electrolyte. In manufacturing or arranging compound plates, *i.e.*, plates which are intended to be used as positive on one side and negative on the other, and to act as containers of the electrolyte, such as, for instance, cone pyramidal or analogous forms of plate; according to the invention the inventor interposes an insulating material between the plates. To effect the insulation he may use Prout's glue, or pitch with or without grease or other suitable insulating compound or material with which he coats or covers one or both of the surfaces before bringing them together, or he may use a layer or sheet of any such suitable material, as India rubber or gutta percha with or without its edge projecting beyond the plates to arrest capillary attraction of moisture from cell to cell when packed in columns, and, in addition, he may make a splayed edge to one or both of the plates which together are to form the compound plate or double electrode or any arrangement of projections, ribs or studs, or raised portions to allow space for a greater or lesser quantity of the insulating material to rest at parts between the surfaces or at the rims, or to make contacts between the plates when desired. A further object of the invention is to manufacture the plates (whether they be flat plates or cones, or of an annular or other suitable shape) that they may be arranged one above the other in columns, piles, or stacks, with openings throughout to allow for the free escape of the gases, and separated with any suitable media, such as strips, plugs, buttons, or pieces of wood, insulite earthenware, or any material and of any form which will ensure the purpose of keeping the plates equidistantly apart and allow sufficient diffusion of the electrolyte.

6312. "An improvement in photometers." W. H. Preece and A. P. Trotter. Dated April 12. 4d. Relates to apparatus applicable to a photometer, whereby equal degrees on a graduated scale are made to correspond with the inverse squares of the distance at which the light acts, without requiring arithmetical computation.

6391. "Improvements in means for electro-therapeutic treatment or so-called electric baths." S. Hallett. Dated April 15. 6d. Relates to improvements in means for electro-therapeutic treatment of human beings, or improvements in so-called electric baths, the object being to employ electricity obtained from the dynamo-electric machine wound and connected for currents of large quantity and moderate intensity, and electrically connected to the apparatus employed through a system of connecting rods and terminal holders or applicances, and thence to the body of the patient or person under treatment, the current being regulated intermediately of the poles by a resistance board having thereon a liquid telescopic glass tube regulator, the inner telescoping portion having platinum terminals, which will be approached to or withdrawn from corresponding terminals in the outer barrel of the telescopic tubes in combination with the metallic coils or convolutions of the resistance board, and in connection or not with induction coil or coils.

6734. "Improvements in electric generators, and in working them by fluid pressure." The Hon. C. A. Parsons. Dated April 23. 6d. According to the invention the generator is driven by a compound motor, or combination of motors, of the turbine type, in which the actuating fluid operates between fixed and moving vanes or blades, the arrangement being such that the same actuating fluid operates in a successive manner, undergoing expansion and falling in pressure in each motor, or successive portion of the compound motor, until it leaves the last at a velocity not greatly exceeding that which is practically attainable by the motor itself, although greatly above that practicable with a motor having oscillating or reciprocating parts. By this arrangement each motor or successive portion of the compound motor utilises a portion of the energy of the fluid, and thus, instead of the greater part being wasted, as heretofore, it is successively drawn upon until a comparatively high efficiency is obtained.

9843. "Frames for electrodes in secondary batteries." F. G. Howard. Dated July 7. 6d. The inventor takes two pieces of wood somewhat larger in area than the electrodes or plates which are to be used. The sides of these two pieces are perforated with holes, so as to allow a sufficient circulation of the electrolyte. The thickness of these two pieces of wood must vary with the size and weight of the electrodes that are to be employed, and the strength that may consequently be necessary. These two sides are held in position by stretchers dovetailed into their ends, and so placed that the grooved end pieces (next hereinafter referred to) may be withdrawn at pleasure. The inventor slides end pieces into grooves cut near each end of these sides. The faces of these end pieces towards the inside of the frame are grooved. Into the grooves on these end pieces he slides wooden partitions; the number of which is varied according to the number of electrodes or plates to be employed in each cell of the battery. These partions are placed at such distances from each other as to allow an electrode or plate to be inserted between, and held in position by, each pair of partitions. Each partition is perforated with as many holes (and of such size) as is compatible with strength, and is grooved on one side. These partitions are so arranged in the frame that there may alternately be a space between two grooved sides and a space between two smooth sides. In the spaces between the smooth sides the anodes are placed, and in the spaces between the grooved sides the cathodes are placed. The ribs formed by grooving the partitions allow any particles that may become detached from the electrodes to fall easily to the bottom of the cell, thus preventing contact or short circuiting between the plates, also permitting the ready escape of any free gas.

CORRESPONDENCE.

Gas Engines for Electric Lighting.

I think that many of your readers would be glad if those of your numerous correspondents with time and apparatus at command would give the results, even if only approximate, of any tests made with gas engines by different inventors. The information which is particularly desirable is, what brake horse-power may be expected from engines of varying ratable values. Thus a 12-H.P. (nominal) Otto engine will indicate as a maximum, say, x horse-power, but what percentage of x, or brake horse-power, may one expect as actually available for driving dynamo machinery for 6 or 8 hours per day. Particulars of this nature taken from any good engine, together with details of testing methods, and the kind of gas used, would be of considerable service to contractors when estimating. The experiments made by Professor Adams some two to three years since at the Crystal Palace are, of course, well known; but I would suggest that the information there contained might be much enhanced in value by the additions which users of gas engines might, in many cases, be able to give. Perhaps the makers of these engines may not be adverse to giving, through your columns, a reply to my queries?

G. A. S.

[Our correspondent has mentioned the tests made by Professor Adams, and in these experiments the gas consumed per brake horse-power was found to be about 30 cubic feet per hour. As an experience of our own we may mention, without going into unnecessary details, that a short time since we were asked to approximately ascertain the brake horse-power of an 8-H.P. (nominal) Otto gas engine. It so happened that the engine was using gas from the same source as that supplied to the Crystal Palace, and the consumption was 365 cubic feet per hour. This represents 12·16-H.P., and the average result of a number of applications of the Prony brake gave 12·25-H.P. We were informed that an engineer from Messrs. Crossley had previously tested the engine which *indicated*, if we correctly remember, 15·8-H.P., equivalent, it was stated, to about 12·3 brake horse-power. It appears, therefore, from these examples, that the brake horse-power of the Otto engines, from 8-H.P. upwards, is at least 50 per cent. higher than their ratable or nominal value, or about 20 to 25 per cent. less than the *indicated* horse-power.—Eds. Elec. Rev.

Bourseul's Speaking Telephone of 1854.

The French newspaper called *L'Illustration*, which contained the description of this, the first speaking telephone, was published in Paris in 1854, and was sold largely in London at that time. A description of it was read before the French Academy of Sciences, and was published in *Les Comptes Rendus* of 1854, which books can be found in Patent Office Library.

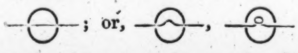
W. C. B.

April 13*th*, 1885.

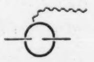
Symbols for Electric Lamps.

Some time ago I suggested in your columns a symbol for the "dynamo" which has found acceptance, and as distinctive signs for electric lamps would also be useful, I may perhaps be allowed to propose the following :—

(1) For an incandescent lamp—



with a loop on the wire to indicate the filament better.

(2) For an arc lamp, 

In the first the wire is continuous through the circle which represents the globe ; in the second the wire is broken to imitate the arc.

At present we have no symbols which distinguish in a simple manner between arc and incandescent lamps ; and those for the latter are either a picture of the lamp or a plain circle, inexpressive of itself, and resembling the small circle sometimes used for a terminal.

A universal code of symbols would be a boon to electricians, since it would enable them to interpret theoretical diagrams of connections by inspection, and independently of the text whatever language was employed in the description of the apparatus.* An international congress or committee is required to choose and authorise these.

J. Munro.

[In the Review for February 9th, 1884, Mr. Munro advocated the use of a symbol for a dynamo and in this respect we agreed with him, mainly for the reason that the figure he proposed could be made up from the type usually found in printing offices. While it is generally advantageous to employ symbols for practical purposes we scarcely think that a universal code for literary use, which we imagine Mr. Munro is aiming at, is necessary or even advisable. To the uninitiated such a proceeding would make electrical science more than ever unintelligible, and we fear it would not be by any means easy to find specially constructed symbols except amongst the publishers of purely electrical works. The *multiplication* of symbols, to be *built up* by the compositor therefore seems to us objectionable, and we fear would prove to be a serious obstacle to their introduction. We incline to the opinion that a combination of letters such as Mr. Jamieson, the Principal of the Glasgow College of Science and Arts, invariably makes use of when describing any piece of electrical or mechanical apparatus, would be found more satisfactory. However, we shall be pleased to have the views of any of our correspondents who may be interested in Mr. Munro's suggestions.—Eds. Elec. Rev.]

Electric Lighting at the Prince's Theatre.

I noticed in your last issue a very interesting article on the working cost of the electric light at the Prince's Theatre for the last year, and consider that great credit is due to Mr. Berry for the trouble he has taken in noting the details so carefully. I would wish, however, to point out, with reference to the accumulators used, that the Electrical Power Storage Company have now completely mastered the difficulties that used to exist in regard to buckling of the plates or falling out of the paste, and that among the 35,000 plates which have been supplied to customers during the last few months not a single instance of either of the above defects has occurred. We have also proved from experimental cells, which have already received the equivalent of a year's work, that the life of the plates has been more than doubled.

Bernard Drake, *Managing Engineer,*
Electrical Power Storage Company, Limited.

4, Great Winchester Street, London,
14*th April*, 1885.

Re-winding Dynamos.

Although it is difficult to imagine how Mr. Moon could have misunderstood Capt. Cardew's letter on the above in your issue of the 4th, it is still more difficult to understand how Mr. Moon can continue to maintain the position he has taken up in reference to this subject. Mr. Moon says, that in converting a series into a shunt dynamo it is necessary, if we are to have the same internal and external work at the same speed, to rewind both armature and field magnets. That this is not necessary becomes apparent when we consider that the internal work in any dynamo depends upon the sum of two quantities without reference to the individual values of the quantities making up this sum. Obviously it is possible to have in the reconstructed shunt machine the same internal work performed as in the series machine, even if both the work expended in the armature and in the field magnets have different values to what they had formerly, provided the sum of the two remains the same. In Mr. Moon's solution not only is the total work expended in the shunt dynamo to be the same, but the separate quantities of work expended in the armature and field magnets respectively are to have the same values as they had in the series machine. In Capt. Cardew's solution, while the total work remains the same, that expended in the armature, by reason of its not being re-wound, will be necessarily higher, while that expended in the magnets will be necessarily less than in the series dynamo. To convert a series into a shunt dynamo which will give the same E.M.F. and current at the same speed, with the same efficiency, is a problem which has frequently to be attacked by electrical engineers, but I venture to think that no one has yet thought of re-winding the armature of the machine for the sake of the small increment of current required to excite the magnets.

Below are given examples of a series machine and two shunt machines, in all of which the same work is performed internally. In example 2 both magnets and armature are re-wound, and in example 3 the magnets only :—

Dynamo Machines.

Current, 70 amperes ; E.M.F., 100 volts.

1. Series Machine.		2. Shunt Machine.		3. Shunt Machine.	
R. of arm.	·1 ω.	Resist of arm. ..	·0874 ω.	Resist of arm. .. =	·1 ω.
R. of F.M.	·1 ω.	Resist of F.M. ..	20·4 ω.	Resist of F.M. ..	23·36 ω.
Watts in arm. .. =	490	Watts in arm. .. =	490	Watts in arm. .. =	552
Watts in F.M. .. =	490	Watts in F.M. .. =	490	Watts in F.M. .. =	428
Total ..	980	Total ..	980	Total ..	980

I have not thought it necessary to work out the figures to several places of decimals, but here at least are two solutions for the winding of a shunt dynamo, although Mr. Moon declares there is only one.

W. B. Esson.

April 14*th*, 1885.

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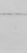
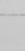
* Other symbols might be for relay, and  or  for secondary batteries.

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LONDON: PRINTED AND PUBLISHED BY THE PROPRIETORS AT [illegible] PATERNOSTER ROW, E.C.—April 18, 188[illegible]